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DEPARTMENT of AGRICULTURE

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Market Gardening,

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By

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State College, Pa.

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PREFACE.

Commonwealth of Pennsylvania,
Department of Agriculture,
Harrisburg, Pa., Dec. 5, 1910.

Bulletin No. 147, published by this Department in 1906 met with so much favor that the greatest care possible was required, in its distribution to prevent an exhaustion of the whole number printed, before those most interested in the subjects discussed were supplied.

The fact that the supply of this bulletin was practically exhausted nearly a year ago, and that calls for literature upon the subject of "Market Gardening" continued to come to the Department almost daily, together with the fact that constant progress is being made in the development of new methods and the improvement of methods that have been in common use, led to the conclusion that there is great need for another bulletin upon the same subject. Arrangements were accordingly made with the same author to prepare "Market Gardening, No. 2," which is sent out in the hope that, like its predecessor, it will prove a great help to those who wish to take advantage of the excellent market facilities enjoyed by the vegetable growers of our State.

N. B. CRITCHFIELD,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

State College, Pa., December 1, 1910.

Hon. N. B. Critchfield, Secretary of Agriculture:

Sir: In compliance with your request, I have the honor of submitting to you the manuscript for a bulletin on "Market Gardening." It is gratifying that the first bulletin on this subject, No. 147, published by the Department of Agriculture, and which I had the pleasure to prepare, has found a place among the farmers and vegetable growers of the State. It is hoped that the second bulletin, which is more comprehensive and better illustrated, will meet the needs of every soil tiller in Pennsylvania who desires to increase profits by the production of high grade vegetables. The instructions are based upon many years of practical experience as well as careful study of the most important market gardening sections of the East.

Yours respectfully,
R. L. WATTS.

MARKET GARDENING.

PENNSYLVANIA MARKETS.

No state in the Union possesses better markets than Pennsylvania. The two largest cities, Philadelphia and Pittsburg, require enormous quantities of vegetables to feed their millions of people. The smaller cities as Harrisburg, Lancaster, Altoona, Johnstown, Reading, Allentown, York, Erie, Greensburg, New Castle, and Uniontown are most excellent markets. Then, there are scores of towns ranging in population from a thousand to ten or more thousand that furnish local markets for a limited supply of produce. The prices are generally satisfactory. There are gluts, of course, which cause low prices for brief periods, but average prices are unquestionably higher than in most states. It is a lamentable fact, however, that the bulk of the vegetables consumed in Pennsylvania is supplied by other states. Thousands of carloads of cabbage, tomatoes, celery, lettuce, asparagus, melons, onions and a long list of vegetables are annually supplied to our markets. Without a tremendous increase in the area of glass, the State could not produce sufficient vegetables for the early spring markets, although there are splendid opportunities for the forcing of greenhouse crops. There can be no doubt about the possibility and desirability of our farmers producing practically all of the vegetables required by our markets so far as climatic conditions will permit.

It is hoped that this bulletin will suggest to many farmers a closer study of their local markets. For example, Where do the onions come from? What prices do they command? Could you grow them successfully on your own farm and would their culture increase your annual profits? A similar investigation might be made of other vegetables for which there is a local demand. There are opportunities in almost every community. It may be the planting of large areas in special crops, or more likely the devoting of small areas to a number of crops. Other lines of farming should not be dropped or reduced until the new lines have been thoroughly tested and found to be more profitable.

LOCATION.

If the farm is to be devoted largely or exclusively to market gardening or trucking, too much care cannot be exercised in choosing a location. A number of factors should be taken into account.

Close proximity to a large city has many advantages. Among them may be mentioned the following: (1) Less difficulty in procuring the necessary labor. This is often a serious matter, and yet the problem is readily solved by those operating on a large scale. Special cottages or boarding houses are often provided and the plan, when properly managed, is highly satisfactory. (2) It is a great advantage to be near large supplies of manure. When stables are cleaned regularly by gardeners the manure is often procured without charge and the prices are seldom more than fifty cents per load of from one to three tons. This makes cheap fertility, although the expense of hauling is quite an item. (3) A short haul to market makes a light expense for this work, while it is heavy for gardeners living remote from markets. (4) A short distance from the city enables the gardener to wagon his produce which is a most decided advantage over shipping. It also enables him to place his produce on the market in the most perfect condition. (5) When near the city the producer gets into closer personal touch with the market and is better posted concerning prices.

It is also important to study the character of the market before deciding upon the location. Prices range higher in some markets of this State than in others. The methods of selling also vary. A central wholesale market where all retailers and hucksters gather to procure their supplies—is, doubtless, the most satisfactory plan from the standpoint of the producer.

Good roads are of primary importance to the market gardener. He can well afford to pay considerably more for a farm located on a smooth, hard, well drained road with easy grades.

Irrigation plays a more important part in market gardening every year. Overhead systems of watering are rapidly becoming popular and it is highly desirable to locate near a constant supply of water which can be obtained and supplied at a minimum cost.

If remote from market, good shipping facilities are important. Two lines of railways, operated by different companies, help to secure better service. It is important to have ready access to several towns or cities.

Sandy loams are ideal for garden purposes. They are easily worked and well adapted to a general line of cropping. Southern or southeastern exposures are desirable if earliness is an important factor. Natural windbreaks of hills or trees assist in producing early vegetables.

SOILS.

It was stated in the preceding paragraph that sandy loams are ideal for a general line of gardening. This fact is universally recognized. Such soils are of easy tillage and well adapted to a

great variety of crops. The large percentage of sand makes them early, while at the same time there is usually sufficient body to make them quite retentive of moisture and fertility. Sand is especially important in the growing of root crops. In soils containmuch clay the roots of such crops, as the parsnip and salsify, will be rough, crooked and probably short. The sandy types always produce the smoothest and most uniform beets, turnips, radishes, parsnips and all other root crops.

The area of sandy soils in Pennsylvania is limited compared with that of the heavier types. This should cause no special concern, for vegetables of the finest quality are grown in every county of the State. The heavier types are well adapted to many vegetables, as cabbage, cauliflower, sweet corn, tomatoes and peppers, while with proper additions of humus-making material all of the vegetables, if climatic conditions are favorable, may be grown with success.

The most undesirable types are the stony soils which are difficult to work and the gravelly soils in which crops usually suffer from drouth. If market conditions are especially favorable it may be profitable to spend considerable money in improving the most undesirable soils.

Reclaimed swamps or muck soils are especially desirable for celery, lettuce and onions. There are various areas of muck land in Pennsylvania, as in Tioga county, on which these vegetables are grown on a large scale.

Thorough drainage is a matter of primary importance. No soil, unless well drained naturally or artificially, will yield satisfactory garden crops.

EQUIPMENT FOR RAISING EARLY VEGETABLE PLANTS.

The kitchen window is a favorite place on many farms for starting early vegetables. It may serve the purpose fairly well if a small number of plants are wanted. Ordinarily, however, plants are too much crowded in windows and they are not generally transplanted until drawn, pale and tender, and plants of this character are not satisfactory. Millions of plants are started in hotbeds and this will always be the favorite plan of most growers. Market gardeners, operating on quite an extensive scale, prefer greenhouses, and there are many arguments in favor of them. The kitchen window, hotbed and greenhouse are used to nurse the plants for a period of three to six weeks and cold frames are then employed in caring for the plants until set in the field.

In addition to the above equipment, provision should be made for mats to protect the plant in hotbeds and frames during cold weather unless these structures are heated by steam or hot water. A

large number of flats or plant boxes are used on many farms. Fifty or one hundred feet of hose will probably be needed, besides hose menders, nozzles, watering cans, planting boards, dibbers, straight edges, labels and earthen or paper pots.

GREENHOUSES.

Greenhouses are not essential in some lines of gardening. A New Jersey trucker, cultivating nearly one thousand acres of land, succeeds admirably without a greenhouse. He grows a variety of vegetables for mid-season and late market but no attempt is made to grow early crops which require a large amount of glass to start the plants. Glass is not needed in celery or onion culture although often employed in starting plants of both of these vegetables.

Many vegetable growers live too remote from market or operate on too small a scale to justify the erection and maintenance of a greenhouse. On the other hand, a large number of gardeners in this State are shifting along with manure-heated hotbeds when they should have greenhouses to start their crops. It is poor economy to shift along with hotbeds when greenhouses would serve the purpose so much better.

All of the arguments are in favor of the greenhouse when a large amount of glass is required. It is more economical to operate, both in fuel and labor required. It is much more pleasant as well as convenient to work in a greenhouse than to stoop over frames, especially if the weather is disagreeable. The greenhouse gives the grower more perfect control of soil and atmospheric conditions. He is inside of the structure where his eye notices very quickly whether the soil is too dry or too wet. The plants are not endangered by probable drops in temperature, because the boiler may be fired more heavily to furnish the proper heat. Fresh air is admitted at will without cold draughts striking the plants as is likely to occur when hotbed sash are raised for ventilation or watering. The air in hotbeds is likely to become too close and steamy, causing damping off, and weak, spindly plants; while these troubles seldom occur in greenhouses, although less attention is given to ventilation.

The greenhouses may also be used in forcing lettuce or other vegetables before the space is needed to start early vegetable plants. This gives employment to the farm hands during stormy weather, and if the houses are properly handled they become a source of revenue when there is no income from crops grown in the open. A greenhouse makes summer the year round on one spot of the farm and this argument, although it relates to sentiment, is well worth considering. Good advice, however, is not to build unless it is plainly evident that a greenhouse is needed.

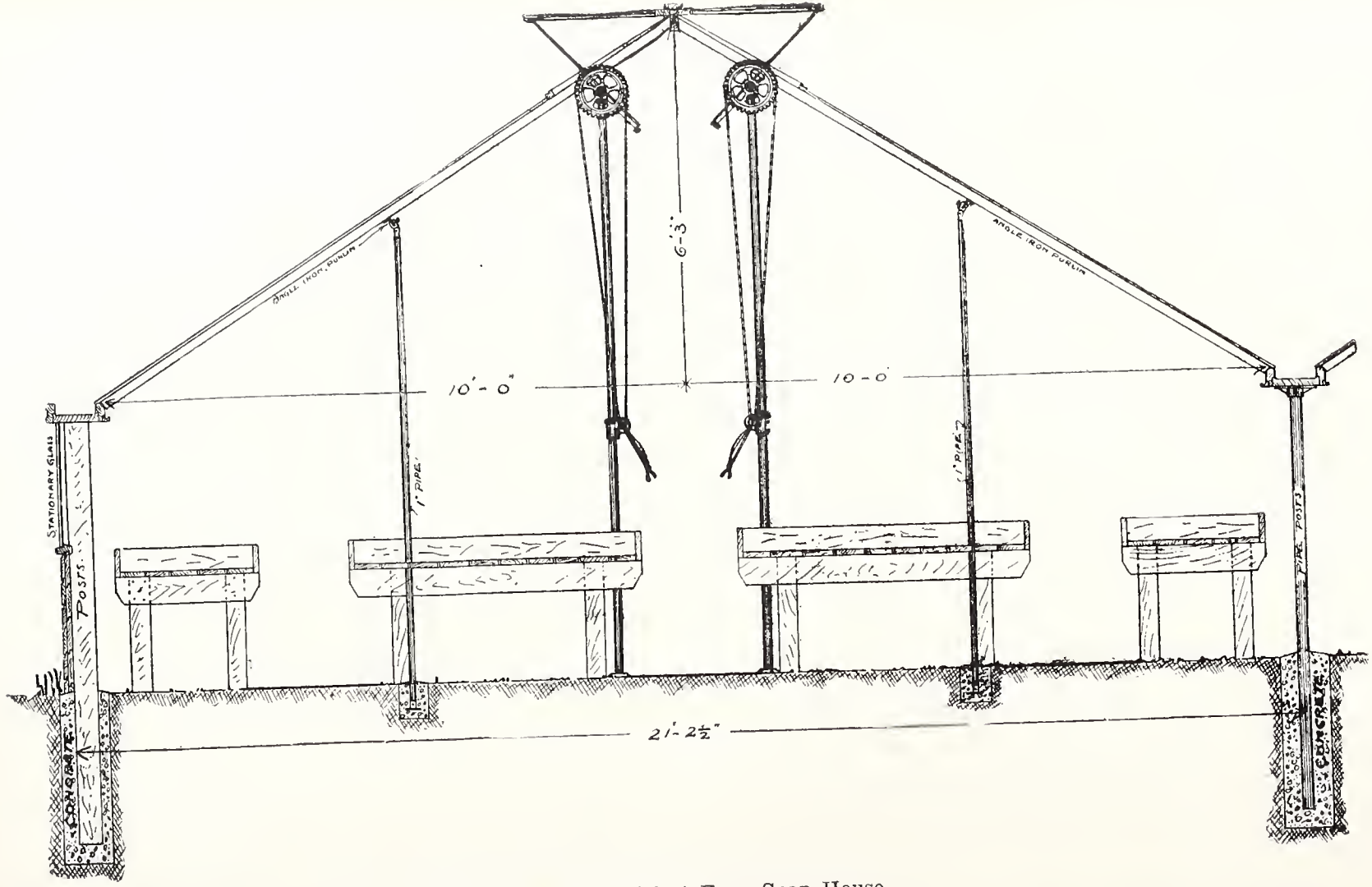

Fig. 1. Cross Section of a 20-foot Even Span House.

It is not necessary to build very large houses unless the forcing of vegetables or flowers is contemplated. A house 30 x 75 feet will serve the purpose for twenty-five to fifty acres of vegetables. If the grower is skillful and can combine vegetable forcing with open ground work, he might be able to use to advantage an acre or more of glass, provided market conditions are favorable. The size of the greenhouse must also be determined by the number of available sash for cold frames. If the plants are merely held in the beds until the first transplanting the house need not be large. At least eight hundred seedlings should be started on every square foot of bed or bench space, if they are to be transplanted in about four weeks.

GREENHOUSE CONSTRUCTION.

Greenhouses may readily be built by local carpenters. It is important, however, for the gardener to make a careful study of the whole subject before buying materials or undertaking the work of construction. "Greenhouse Construction," by Professor L. R. Taft, is the only complete book on the subject. It may be procured through any well known publishing house. The catalogs issued by the various building firms are also instructive. The prospective builder should visit and study well built houses to become familiar with details which enter into the construction of all classes of greenhouses. It is not the purpose of this chapter to discuss the details of greenhouse construction, but a few suggestions may be helpful to inexperienced builders.

The location is important. The house should be protected, if possible, from hard northern or western winds. It should be comparatively near the dwelling and convenient to the cold frames. The water supply must also be considered in locating the greenhouse.

There are various forms of greenhouses; the lean-to, hillside, three-quarter span and even span. Of these types, the even span, as shown in Figure 1, is the most popular although there are hundreds of three-quarter span houses. Definite experiments show that none of these types has any superiority over the others. It is largely a matter of preference, although the three-quarter span houses are better adapted to hillsides unless the ground is first graded. Houses which run northeast and southwest are satisfactory, although the position of the house with reference to the rays of the sun at different periods of the day is a matter of little consequence.

It always pays to use the best materials and to buy from reliable builders. The wood parts should be well air-dried cedar or cypress. A number of well known firms make a specialty of sash bars and all other wood parts which are cut, when possible, in the proper lengths at the factory thus making the carpenter work a simple matter.

Full iron frame construction is on the increase, but the cost of building is so much greater than semi-iron construction that the latter plan is preferred by most growers. All wood parts should be given two coats of paint before glazing and a third coat after the glass is laid. It is economy to build houses which are not less than thirty feet wide. The roof should not be too flat or too steeep. Most houses are built with a pitch of thirty to thirty-five degrees. The posts or walls should be durable. Formerly, wooden posts were used exclusively. They are seldom used now, for iron pipe posts and concrete walls have been substituted. Pipe purlins and interior posts and braces are also in common use. The King form of construction obviates the use of interior supports.

It is desirable to use double strength A glass. Cheaper grades break more frequently by the freezing of water under the laps and the loss caused by large hail-storms would be much greater. The freedom from blemishes is also an advantage. Sixteen by twenty-four inch glass is used the most extensively, although larger sizes are frequently used. Some houses are built with the sash bars twenty-four inches apart while the majority of builders object to more than twenty inches between sash bars. At this distance, glass either twenty by twenty-four, or twenty by thirty, may be used. To secure the best glazing, the glass should be laid in putty with the convex side up and care exercised in grading glass so that the laps, which should not be more than one-fourth inch, fit tightly. A number of good glazing points are on the market. The Peerless is one of the best.

Raised benches are rapidly passing out of use. Their cost of construction and maintenance is in itself a serious objection. The main reason for their abandonment, however, is that in the forcing of all classes of vegetables, better results are obtained in solid beds. Cement sides, about three inches thick and a foot high, are often used to the solid beds but even these are not considered an advantage in most successful commercial establishments. It means, then, that the entire area of the greenhouse is one plat to be farmed in a most intensive manner without the interference of benches, pipes, concrete sides of beds or concrete walks. Large doors are often provided at the ends of the houses so that teams and wagons can pass in and out with soil and manure. Plows and harrows may be used almost as freely as in the open. Alleys or walks are provided as may be necessary. (See Figure 2.) All heating pipes are along the sides or overhead. It is by far the most economical arrangement, and experience teaches that it is entirely satisfactory. Raised benches are convenient for certain lines of work, but from a business point of view they receive the support of a very small per cent. of our vegetable growers.

Fig. 2. A convenient house at the Pennsylvania State College. All heating pipes are along the side or overhead.

Both steam and hot water are extensively used in greenhouse heating. Each system has its staunch friends. It costs more money to install a hot water system, but it is more economical to operate and the pipes when kept filled with water are more permanent. With hot water, the boiler may be left for a longer period at night without attention because the pipes when filled with circulating warm water retain heat much longer than steam. Hot water, therefore, is much more desirable for small houses than steam because the gardener can get along without a night fireman. Whatever the system, it is important that a boiler and radiating surface of pipes be adequate to maintain the proper temperatures in the coldest weather. With a first-class hot water system, it is possible to leave the boilers for seven or eight hours even at zero temperatures outside.

No greenhouse plant is complete without a good potting or transplanting room. It is often convenient to have this room over the boiler room or adjacent to it. See that it is properly heated, ventilated, lighted and well provided with good work tables or benches. This room should be made pleasant and comfortable to secure the best service of the workmen.

SASH FOR HOTBEDS AND COLD FRAMES.

In the purchase of sash, it is economy to buy the best material. Well cured cedar or cypress should be used, although white pine is considered just as durable by some who have had many years of experience in the management of frames. A prominent gardener of Philadelphia county is using quite a number of white pine sash which were bought at least twenty-five years ago and they are still in good condition. Cedar or cypress, however, are generally used.

Sash differ greatly in style of construction. A bracing rod in the middle is highly desirable, but many firms do not use it. The joints should always be leaded and the lumber smoothly dressed. The standard size is three by six feet, although larger ones are used extensively in Philadelphia county. They also vary in thickness from one and three-eights to two inches. The lighter sash are easier to handle but less durable and more likely to be lifted and broken by the wind.

In glazing sash either of these two methods is used, to butt the glass which slides in grooves, or to lap the glass which is the more popular plan. There is greater leakage when glass is butted and the sash is probably not so durable with the open grooves which collect and retain moisture. Ten by twelve inch glass is almost universally used in the three by six foot sash. Smaller lights are in common use on the larger sash, but there are serious objections to small panes. It is true, that in case of breakage, the cost of repair is less, but sash are much more tedious to glaze when the lights

are so small and the additional bars and extra laps materially reduce the amount of light that can enter the frames.

Sash should be given two coats of paint before glazing and one after. They should also be painted every other year and stored in the dry or stacked when not in use.

DOUBLE GLASS SASH.

Two firms at least are placing on the market double glass sash, and many gardeners desire information regarding their merits as compared with single glass sash. Double sash are made thicker so it is possible to provide a more or less dead air space between the two layers of glass.

The advantages are as follows: (1) Plants are afforded almost, if not altogether as thorough protection as with single glass covered with mats. It is possible, however, that single glass sash and new rye straw mats will give better protection during severe weather. In many parts of the country double sash should give all the protection needed by plants ordinarily grown in frames. (2) The labor bill in the management of frames is reduced because there are no mats to be handled morning and evening. (3) The plants receive the light during the entire day because there are no mats at any time to obstruct the light. (4) A growing temperature is reached earlier in the day and is maintained longer unless there is little or no sunshine.

The following disadvantages may be stated: (1) Double glass sash cost at least one-third more than single. (2) They are much heavier to handle but will be broken less by the wind lifting them. (3) They may not be so durable. Some growers claim that the condensation of moisture between the glass will shorten the life of the sash. It is held by some that this moisture and the accumulation of dirt between the glass reduces the amount of light entering the frames, and thus weaker plants result. There is a place in gardening for double sash, although the cheaper and lighter single form with mat protection when necessary will doubtless continue to be popular in most sections.

MAKING HOTBEDS.

In the absence of greenhouses, hotbeds are necessary to start early vegetable plants. They are heated in various ways, sometimes by flues running the length of the frames a few inches or perhaps a foot or more under the surface of the ground. Steam from farm boilers is also quite a satisfactory method when it is forced through drain or sewer tile placed a few inches below the surface of the soil in the frames. Steam or hot water may also be used, as in the heating of greenhouses, and this method is unquestionably the most

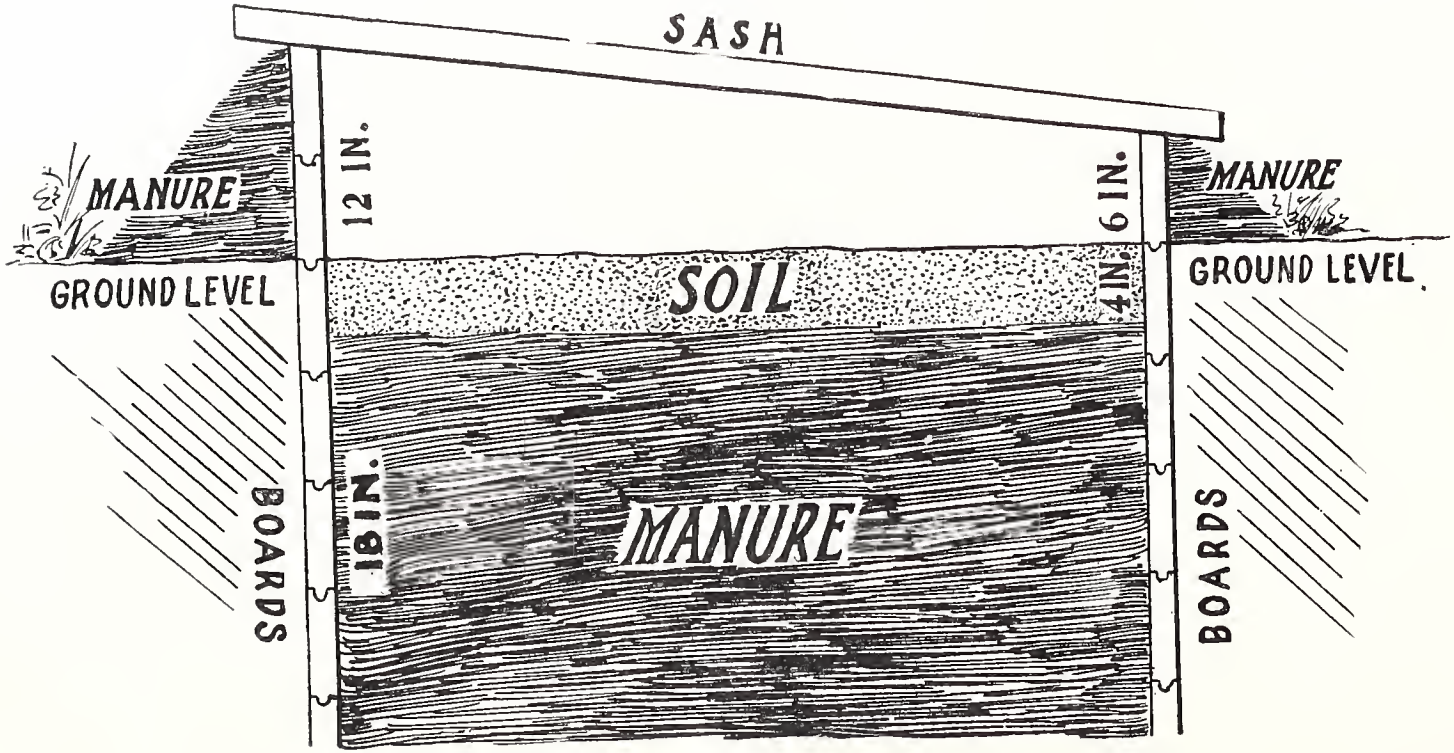

Fig. 3. Hotbed Showing Plan of Construction.

satisfactory when it can be employed. The use of fermenting manure, however, is the plan which is most common.

The hotbed should be near a building which can be made warm and comfortable for seed sowing and transplanting. It should have natural or artificial protection from hard winds and convenient to the supply of water. A southern or southeastern aspect is essential in order to get the full benefit of the sun.

If the land is poorly drained the manure may be placed on the surface of the ground, resting the frame on the flattened area, and banking with manure on the outside. A very much better plan is to dig a pit of sufficient depth to hold the manure. This work should be attended to in the fall before the ground is frozen. It should be of the same width and length as the frame to be constructed. Its depth will depend upon a number of conditions. Twenty-four inches is ample for most purposes in all parts of this State. Eighteen inches would do for the southern part of the State. If heat is wanted for a longer time than usual in the starting of early plants in the spring, then the depth of the pit should be greater and the quantity of manure increased.

Concrete may be used for the sides and ends of the frame. It need not be more than three inches thick and should extend from the bottom of the pit to the height desired. This form of construction is somewhat more expensive than when lumber is used, but the desirability of such a frame renders it the most economical in the end. Wood of a durable character, as chestnut, should be used if the frame is made of lumber. Wooden frames are often made in sections to accommodate three or four sash and then the sash may be stored when not in use. Sometimes the corners are mortised, or pinned so that the frames may be taken apart quickly and the separate parts stored in small space. Two by three cross bars are convenient in the handling of sash, although some gardeners do not go to this additional expense. If the location is level the north side of the frame should be about twelve inches above the ground and the south side about six inches. The boards, which should be not less than one and one-fourth inches thick, should be nailed to stakes or posts on the outside of the frames.

Fresh horse manure is by far the best material for filling the pit. Leaves and other kinds of manure may be mixed with the horse manure but this is seldom done. Shaving manure is unsatisfactory. The horse manure should be by volume about two-thirds solid excrement or fine material and one-third straw. The heat is violent and of short duration if the manure contains insufficient straw, and if it contains too much it may fail to ferment properly and to give the required heat.

If the manure is saved from a few horses it should be kept under cover and spread thinly to prevent fire fanging. When hauled from livery stables or saved in the home barn, stack in piles ten days to two weeks before you desire the use of the hotbed. These piles should be not more than five feet wide and four feet high and as long as may be convenient. The manure should be tramped quite firmly as the pile is built and it is very much better to do this work under cover unless it will be protected from rain and snow. In about three or four days fermentation should be well under way and the interior of the pile quite hot. The manure should then be restacked in the same manner, placing the outside of the first pile in the interior of the second. In about two days the entire pile should show vigorous fermentation and the manure should then be hauled to the pit. If dug in the fall, coarse manure or leaves should be thrown over the bottom to prevent freezing. After removing this throw in the manure in layers, firmly tramping each layer, until the manure, which is kept level, is within a few inches of the top of the frame at the south side. A thermometer is then plunged into the manure and the sash placed on the frames. If good manure has been properly prepared the temperature will rise very rapidly to 120° or more, but it is not safe to sow seed until it drops to 90°. If seed is to be sown directly in the frame not less than four inches of soil should be placed on the manure. If flats are used, two inches of soil will be sufficient to absorb the steam or odors that may rise from the manure. Figure 3 shows a typical hotbed.

MAKING COLD FRAMES.

A cold frame, in the strict sense of the word, is never heated in any artificial way, although many frames are heated by steam or hot water conducted in iron pipes. When steam is used a single coil of one to one and one-half inch pipe secured to the sides of the frame will provide ample heat for most purposes. The more common practice is to construct the frame on ground which has been graded level and not use any means of artificial heating. The usual slope to the south of six inches is provided and the frames banked to the top with manure, sods or soil. Concrete may also be used for the sides and ends of the frames. Cross bars are also convenient in the management of the frames. The sash bars may be fitted in the frames without nailing and then they are easily removed if the frame is wanted for summer crops. (See Figures 4 and 5.)

Cold frames should be located near the building where the transplanting is done if flats are used. If the land is not too valuable, at least ten feet of space should be allowed between frames to take care of snow when shoveled from the frames, also for the manipulation of sash and mats and for driveways. Near the large cities

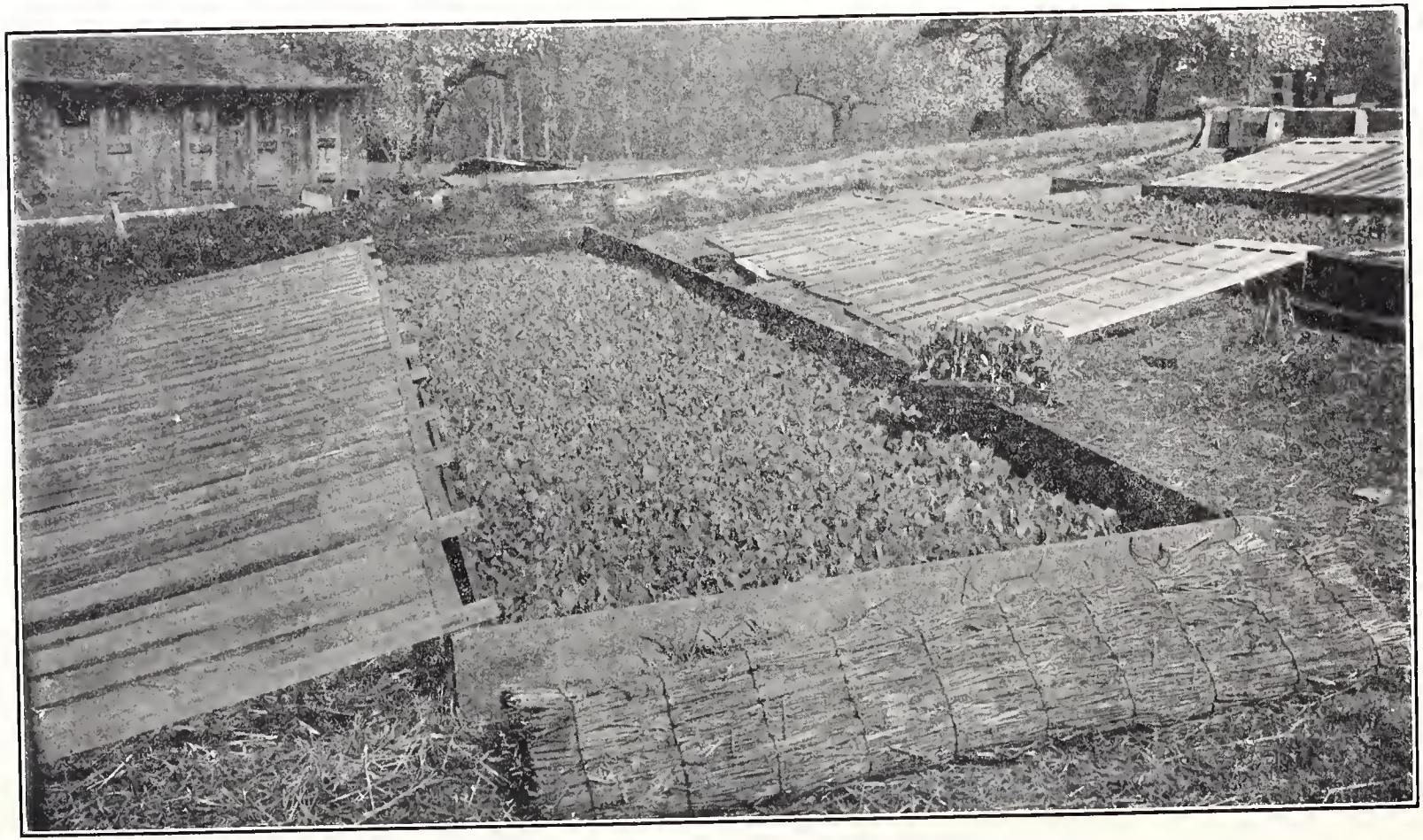

Fig. 4. Cold Frame of Cabbage Plants. Straw Mat at the End.

where land is very high priced, alley ways range from two to three feet in width as shown in Figure 5. These narrow paths prohibit the removal of sash unless they are carried to the ends of the frames.

USES OF HOTBEDS.

In market gardening, hotbeds are used most largely in the starting of early vegetable plants to be transplanted in the cold frame after they are three to five weeks old. Certain classes of plants, as tomatoes, cucumbers and muskmelons are started in hotbeds and then transplanted in the field when weather conditions are right, without the intervention of cold frames. Hotbeds are extensively used about many of the large cities in the forcing of vegetables for market. They may be operated during the entire winter, although the fall and spring seasons furnish best conditions for their management. It is a bothersome method compared with greenhouse culture, but with skillful management gives fair returns. A great many farmers are cultivating rented land and they do not care to spend money for greenhouses when they may be compelled to abandon their places the next year. If the land is worth $1000 or more per acre and the gardener has only a few acres he may operate hotbeds all winter and use the same ground for summer crops.

If the hotbed is used merely for starting early plants in February or March, it is easily possible to follow with radishes or lettuce which will be ready for market when prices are usually satisfactory. Or, the same space may be used as cold frames for forwarding various kinds of plants preparatory to setting in the field. Another use for the spent hotbed, is to grow cucurbits as cucumbers and muskmelons, or tomatoes, maturing these crops early in the summer after the sash have been removed and stored or stacked. Some gardeners find hotbeds very profitable in forcing rhubarb which may be done at any time after the roots are fully matured in the fall. This crop is sometimes forced on a very large scale in hotbeds.

THE USES OF COLD FRAMES.

The cold frame has two distinct uses, namely, the protection of plants during cold weather and the forcing of plants or crops. An example of the first is the protection of cabbage or cauliflower plants from about the middle of October until conditions are right for planting in the open the next spring. Pansies, violets and other ornamental plants are often protected in cold frames during the winter. The cold frame is also very serviceable in rooting bulbous plants wanted for flowering at any time during the winter or spring.

The more common use of cold frames is to care for cabbage, cauliflower, lettuce, tomatoes and other plants after they have been transplanted from the kitchen window, hotbed or greenhouse. (See Fig-

ure 4.) Some gardeners grow a million or more plants by this method. It is also a fairly common practice to sow seed of the vegetables just named in the cold frame, transplanting directly to the field. It is always better, however, to transplant at least once before setting in the field.

Cold frames are largely used in forcing lettuce and radishes in the spring and fall. If a few steam or hot water pipes are provided they may be used all winter although greenhouses are much better for midwinter work. Cold frames may be used in maturing cucumbers, muskmelons, watermelons and all other vegetables which command better prices when matured earlier than is possible without glass. The cold frame plat should be cultivated during the entire summer. If cross bars are used they may be removed and also the end boards, and crops grown in the frames as well as between them. Figure 5 shows how frames are handled in most of the gardens in Philadelphia county. This is a much better plan than to allow them to grow up with weeds, thus harboring field mice and other pests and making the place unattractive.

FLATS OR PLANT BOXES.

Seeds may be sown or plants set directly in the soil of the hotbed, cold frame or greenhouse, but for many purposes and for many reasons it is desirable to use flats or shallow plant boxes.

The advantages of flats are as follows: (1) Inclement weather cannot interfere with the work because sowing or transplanting may be done in a comfortable room, carrying or hauling the boxes to the hotbed or cold frame. (2) The comfort of doing the work in a warm, well lighted room is an important consideration. Because of this comfort the work will be done better and more rapidly than is possible when bending over a frame. (3) There is better control of soil moisture in flats although more attention is required. Better plants can be grown in flats than without them. (4) Flats are a great convenience in hauling plants to the field. The boxes are well watered the evening before transplanting and then the wagon is driven between the frames, flats of plants loaded, hauled to the field and distributed along the rows. This is a great advantage over lifting the plants from solid beds. (5) In shipping or selling plants locally the flats possess advantages. They may be crated or simply loaded on the wagon of the purchaser, the flats being returned if desired. If the plants are retailed at local markets flats are indispensable. It is then possible to make sales two weeks or more before the plants are actually needed, for the purchaser knows that he can easily water and care for the plants until he is ready to set them in the garden. Merchants can also buy in dozen lots, keep the boxes watered and retail as desired. In removal of plants at the time of

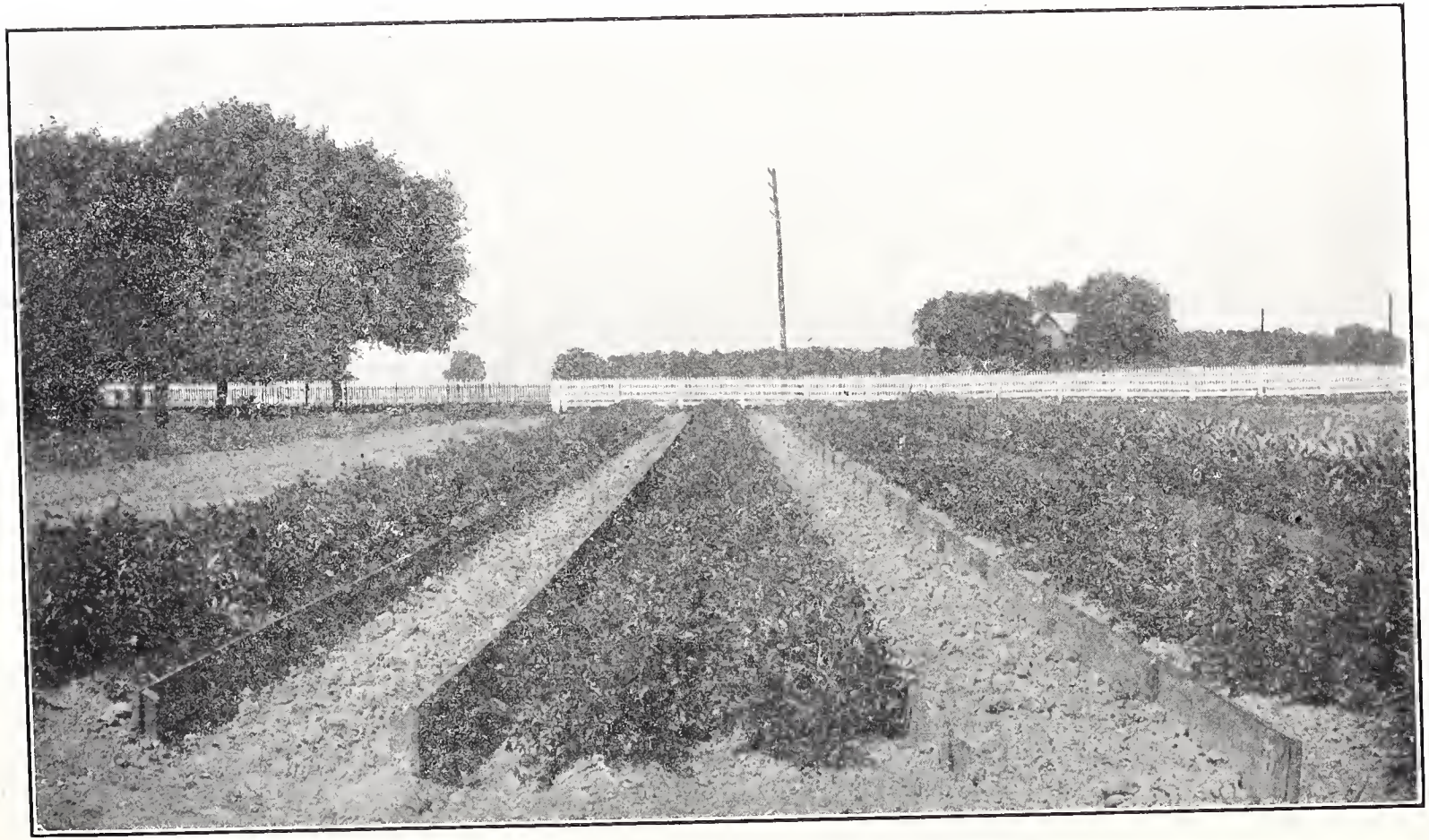

Fig. 5. Potatoes in Cold Frames. End Boards Removed.

setting a block of soil or composted manure may easily be retained on each plant, as shown in Figure 6. This is a most decided advantage for the plant will scarcely wilt when set in the ground. Growth proceeds with little interruption, making it possible to reach the market several days or a week earlier than if the ground is stripped from the roots.

A great many flats are made from empty store goods boxes. This is an economical plan and quite satisfactory. It is usually better to buy chestnut or other durable wood although at present prices flats from new lumber cost more than most gardeners are willing or can afford to pay. Whatever the lumber used, the bottoms and sides should be of half-inch stuff while the end pieces should be not less than three-fourths of an inch. If the flats are only ten or twelve inches in size, which are sometimes used for the retail trade, thinner lumber may be used for all the parts.

In the making of flats, it is seldom desirable to have a greater depth than two inches. Deep flats increase the cost of making them require more soil and manure in filling and make heavier work in handling. A fourteen-year-old boy can easily carry quite a large flat two inches deep while he would find difficulty in handling filled flats three or four inches deep. Deep flats require less attention in watering, but this is the only argument in their favor.

A very common size of flats is about 16x22 inches. They should run uniform in dimensions and be made to fit on the greenhouse bench, in the frames and market wagon without loss of space. It pays to figure out this matter very carefully. It is never desirable to have the boxes longer than two feet. While flats are convenient for most purposes in growing plants they can often be dispensed with to advantage in greenhouse work.

POTS.

When plants are grown in flats there is necessarily some check in growth when they are set in the field. To avoid this loss of time the earliest plants are often set in pots and sometimes shifted once or twice to larger pots before setting in the field. The practice is increasing and is well worth the consideration of market gardeners.

Earthen flower pots are, of course, the most satisfactory. If well cared for they will last for many years, and it is probably economy in the end to lay in a supply of the best grade pots for this work. In recent years, paper pots have come into use and they are now used quite extensively. Any kind of rather heavy paper may be used in the making of paper pots. Ordinary wrapping paper used by merchants serves the purpose very well. The pots may be made of any convenient size. Figure 7 shows the block used in making paper pots. It is bolted to a board, the paper folded about the block, lapping on the

sides over the top of the round end of the bolt and clinched with an upholstering tack. These pots may be made rapidly by children or the work may be done by regular hands in stormy weather. The pots fit together closely without loss of space. Unless the paper is very light it should be removed when the plants are set in the field. The paper need not cost more than ninety cents per thousand for two inch pots. Four inch pots should be used for some purposes as the starting of cucumbers and melons and for tomatoes at the second transplanting.

TRANSPLANTING BOARDS, HOSE AND NOZZLES.

A very useful device in the transplanting of seedlings is the board shown in Figure 8. It will be seen that this board consists of two pieces cleated at the ends. It should be large enough to cover the largest flats that may be in use. The holes should be bored with a three-quarter inch bit. The distance between them should vary with the kind of plants to be set. For cabbage and cauliflower the usual distance is one and one-half inches each way, while two inches is not too much space for tomatoes and lettuce. The edges of the holes on the upper side of the board are slightly beveled to receive the dibber more readily. The dibber is also shown in Figure 7. With this device exactly the same number of plants are set in each box,, and the rows are straight. For instruction on the use of transplanting board see notes on "Raising Early Vegetable Plants," page 23.

Fifty or perhaps one hundred feet of rubber hose is essential to reduce the labor in caring for plants. It should be of the best material and not less than three-fourth inch size. When it becomes worn and begins leaking the defective parts should be cut out and the hose repaired with the brass mender shown in Figure 9. This requires but a few minutes and that part of the hose is then absolutely water tight. When the hose becomes so worn that it is not worth repairing the menders may be cut out and used again. Figure 9 illustrates two nozzles which are exceedingly valuable in watering plants. The square form with the bent neck has some advantages over the round nozzle. If the discharge is not free enough the holes may be enlarged with an awl or the point of a file.

MATS.

Early vegetable plants are often started in hotbeds about the first of February and transplanted in the cold frame about the first of March. At this season of the year severe weather would be certain to destroy plants were they not protected at night with mats, unless the frames were heated as previously explained.

Various kind of mats are on the market, as burlap stuffed with waste cotton or wool materials, canvass mats or rye straw. The first mat named is difficult to handle and to keep on the frames in windy

Fig. 6. Plant Removed from Plat with Soil Attached to Roots.

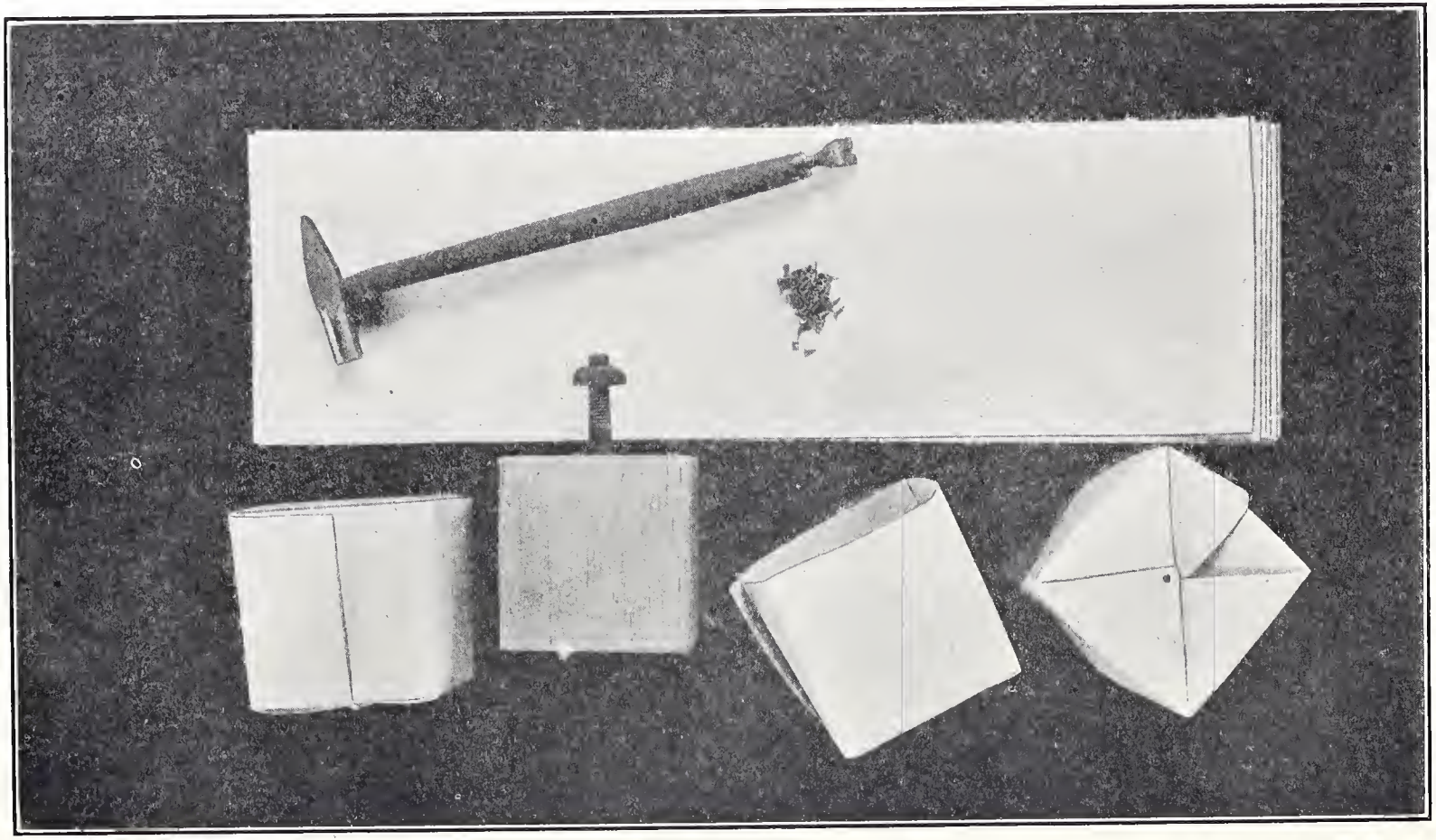

Fig. 7. Paper pots and outfit for making them.

Fig. 8. Transplanting Board and Dibber. Garrahan Weeder Below.

weather because it is so light and flimsy, making weighting necessary, and the canvass, which is water-proof, is too expensive to buy in large numbers. The rye straw mat, all points considered, is unquestionably the best mat on the market. It is as easy to handle as any other mat, does not require weighting on the frames and gives thorough protection to the plants. Figure 4 shows a rolled up straw mat at one end of the cold frame. Most of the books on market gardening give instructions for making these mats at home. This work, although rather tedious, may be done on rainy days. Straight rye straw should be provided for the purpose and it should be protected from mice and rats. High grade straw mats are now made by machine and sold at prices which scarcely justify making them by hand.

The life of straw mats depends largely upon their care. It is easy to destroy them in a single season if carelessly handled while they should last several years if given the proper attention. Most mats are six by six and a half feet and are intended to cover two sash with the ends lapping over the ends of the sash. To remove the mats, walk along the alley on the upper side of the frame and take hold of the mats at the ties of the tar strings and draw them from the frames. It will facilitate the work of covering the frames in the evening if the mats are folded back until the edges meet and this will also keep one side of the mat dry in case snow should fall during the day. If several inches of snow has fallen during the night it should be shoveled or scraped off before attempting to remove mats. If the mats are wet and heavy, walk along the lower side of the frame, catch them at the ties and fold them over toward the upped side as far as may be convenient. Then, this lapped over end can be easily reached from the upper side of the frame and the mat removed without much strain on the two cords. If wet when removed in the morning they should be spread to dry or if not too many they may be hung on wires or other supports. To cover sash, step on the mat if it is spread out flat, reach behind, catch the mats at two places where the cords are tied and walk across the frame on the sides of two sash immediately above a cross bar, drawing the mat across both sash. By a little practice the mat can be readily dropped to place without much further attention. Mats should be hung up and thoroughly dried when no longer needed for the protection of plants and then stored where they will not be damaged by rats and mice. A very good plan is to store on platforms suspended from rafters in the barn.

GROWING EARLY VEGETABLE PLANTS.

Success in market gardening depends largely upon reaching the market early when prices are good and produce finds ready sale. To accomplish this it is necessary to grow strong, thrifty plants which have been hardened and ready for the field the first day weather and

soil conditions are favorable for transplanting. If the plants are for sale it is equally important to have them ready when the patrons want them and it is just as important to have high grade plants as when they are to be used on your own farm. The production of strong vigorous plants is a matter of good management. The frames or greenhouses cannot be neglected and then satisfactory results expected.

Work begins in the fall by the selection of good soil. Some growers prepare the soil during the summer by making an application of several inches of manure on any good soil in the spring and plowing this plot several times during the season. Additional manure may be added at the second plowing if vegetable matter is wanting. Other growers go to the trouble of stacking manure and thick sods in alternate layers of eight or ten inches a year in advance of the time when the soil will be needed. When quite well decayed the pile may be turned several times at intervals of ten days or two weeks. The first plan is more economical and just as satisfactory. Other growers prefer to select any good garden soil and add rotten manure as may be required.

In the selection of soil, it is important to consider several factors: (1) It should be free from fungus diseases, as club root and other maladies that might cause trouble. Fields which have been producing any of the crops to be started under glass should be avoided in the selection of soil. (2) Stones, sticks and other rubbish should be screened out. (3) Soils containing a great many weed seeds should not be used. (4) A considerable quantity of sand is always desirable. If the soil does not contain this naturally, it can often be procured at small cost and added as may seem desirable. Sand is especially valuable in starting tender seedlings. The addition of plenty of rotten manure to any good farm soil will usually put it in good condition for growing vegetable plants.

Both the soil and manure should be procured in the fall before the hard freezing weather and stored in the dry where they will not be frozen hard when wanted for use, probably in mid-winter. The neglect of this matter is certain to cause annoyance. It is best to store the soil during September when it is quite dry and may be screened if necessary. A convenient way to do this is to place a screen with a half-inch mesh over a low wagon, slanting it so the stones and coarser parts will run onto the ground. This will obviate the necessity of screening in the winter time unless some very fine soil is wanted for special purposes.

Sterilization is being practiced more and more by plant growers. It destroys troublesome weed seeds and greatly reduces losses from fungous diseases. There are two common methods, namely, by steam and formaldehyde. There are various ways of applying the steam.

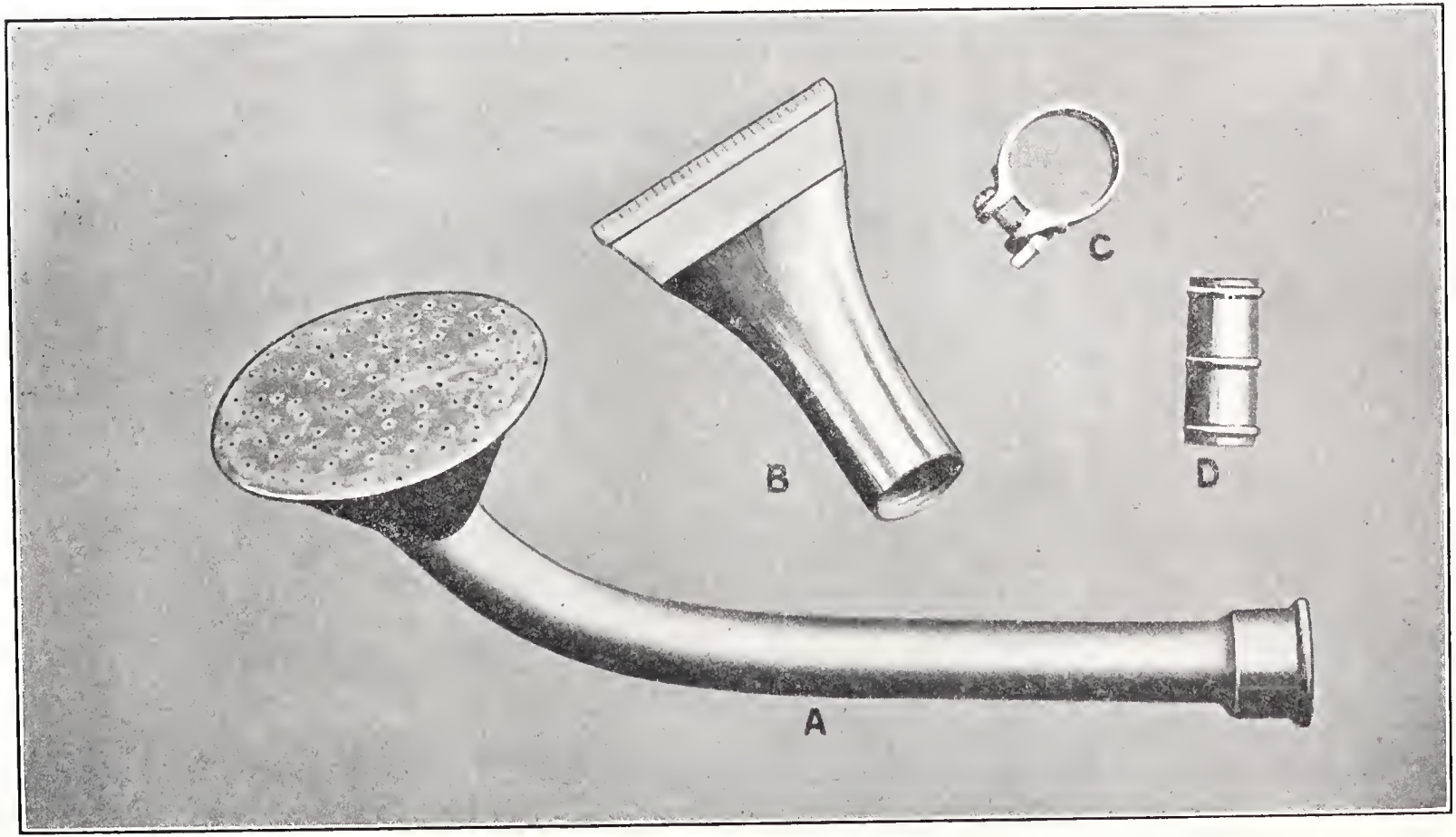

Fig. 9. A. Circular nozzle. B. Circular nozzle. C. Hose-clamp. D. Hose mender.

One of the most thorough is to place the soil in tight tanks, admitting steam at high pressure. The soil should be subjected to very high temperatures for not less than an hour, and a longer period is an advantage.

When formaldehyde is used the soil is soaked with a solution made by adding one and one-half quarts of this solution to fifty gallons of water. One gallon of the diluted solution should be applied to each square foot of soil.

The grower should know the vitality of his seeds before sowing. This may readily be determined by making a simple test several weeks before it is time to make the main sowings. Count one hundred seeds of each variety to be tested and plant in separate rows. The number of plants which come up may then be counted and the germinating power accurately determined, and the thickness of sowing regulated accordingly.

Seeds may be sown in rows or broadcast. The row method takes more time, but it is preferable. The plants then come up with greater regularity. They are likely to be straighter and can be handled more rapidly. When the seed is sown in rows the plants help each other in reaching daylight and this is an important point if there is much clay in the soil. The plants from rows may be lifted more rapidly and are kept in better order when transplanting and these advantages more than offset the extra time required in sowing.

See that the flats are level full before sowing begins and that the soil is well firmed along the sides and in the corners of the beds or flats. A straight edge should be provided to make the furrows. These furrows may be one and one-half inches apart if the space is limited, although a two-inch space is better and is more commonly used. When the furrows are closed there should be about one-fourth inch of soil over the seeds although less amount is better for celery seeds unless the soil is very loose. In closing the furrows the straight edge or piece of lath may be drawn lightly and carefully over the rows or the work may be done with the fingers or a pot label. The soil works much better if fairly moist. It may be properly moistened before sowing by sprinkling with hose or watering can as it is shoveled into a second pile.

Inexperienced gardeners are usually perplexed about how thick to sow seed. Twelve seeds per inch of furrow will usually make a good stand. You should count on at least ten plants in this distance and this will make over a thousand plants in a flat of ordinary size. If the seed is sown too thickly the plants will be crowded and become weak and spindly and they will then be tedious to transplant. Figure 10 shows a flat of cabbage plants ready for the field.

After sowing, the boxes or beds should be watered thoroughly. More water should not be needed until the plants are coming up,

although it may be necessary to water dry spots before germination is complete. Be careful not to overwater. The soil should be kept moist but not wet. It is better to water in the mornings and the plants will then dry off before night, lessening the danger of damping off.

Ventilate every day if possible, but guard against cold drafts striking the plants. See that proper temperatures are maintained. For this information refer to notes on the culture of the various crops.

Seedlings are usually transplanted about four weeks from sowing. The question of time, however, is of no great importance so far as the plants are concerned unless the work is delayed so long that they get tall and spindly. In the growing of most plants as cabbage, lettuce and cauliflower, transplanting usually begins three weeks from sowing and is continued two weeks. Some gardeners begin transplanting when the rough leaves are about the size of peas.

If flats are to be used, about three-fourths of an inch of rotten manure should be placed in the bottoms before filling with soil. Perhaps the chief advantage in using manure in this manner is that it facilitates getting out the plants with a block of soil attached to the roots, as seen in Figure 6.

In filling a flat after the layer of manure has been placed in the bottom, see that the soil is firm over the entire box and well pressed into the corners and along the sides. This precaution prevents too much settling and the soil does not dry out so rapidly.

The transplanting board, as illustrated in Figure 8, is now placed over the filled flat. It is important that the board rests firmly on all parts of the soil to prevent filling of the holes when the dibber is removed. A home-made dibber may be substituted for the iron dibber if desired, but the iron tool is better and more durable. It is most convenient to begin punching in the back row and working from side to side. This work, after a little practice, will be done very rapidly by a boy and he can prepare flats as fast as several persons can transplant. The punching should be done on a solid table or box of convenient height to the operator. After making holes, the box is removed to a bench where the work is continued. Several boys or girls can drop the plants. The weakest plants should be discarded. Time will be saved by dropping plants in the back row first, always working from left to right, and leaning plants backward. The work of fastening the roots should be done by older persons who will see that the soil is pressed firmly about the roots of every plant. Fastening may be done with the fingers, or by the use of the forefinger of the left hand and about a three-eight inch dibber held in the right hand.

Many gardeners do not use the transplanting board, but it is unquestionably a decided advantage, especially if children or careless workmen are employed. When a transplanting board is not used the

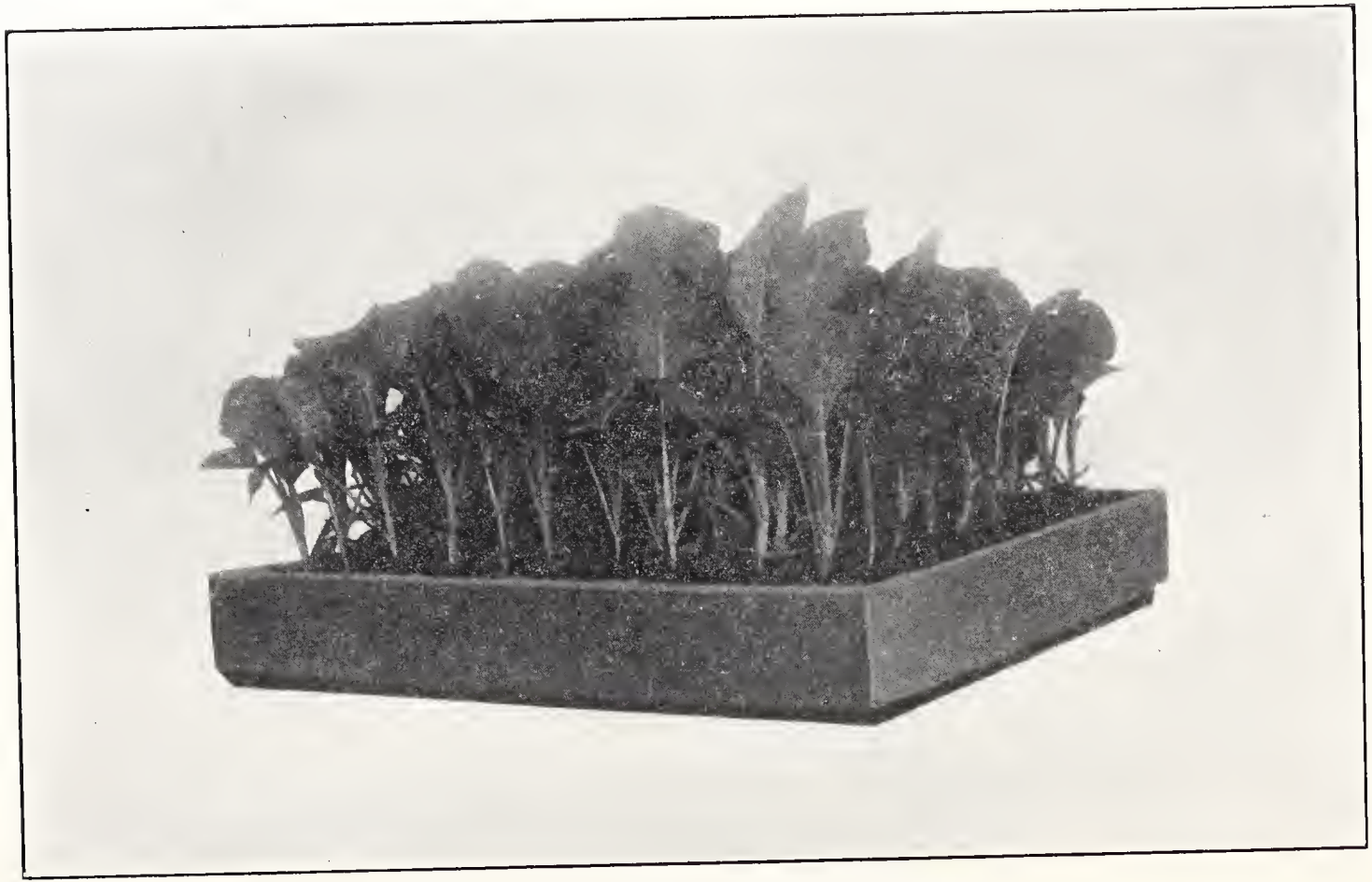

Fig. 10. Cabbage Plants Ready for the Field.

holes are generally made with a dibber of suitable size held in the right hand and the roots are covered and secured with this small tool while the plant is held in place with the left hand.

It is very important that the soil be properly moistened before planting begins. The work will not only be performed better and more rapidly, but watering will be necessary immediately after the plants are set which is of some advantage although the usual plan is to apply water very soon after transplanting. When the boxes are carried or hauled to the cold frame or placed on the greenhouse bench, many growers prefer to delay watering until the next morning when the plants are more rigid and will not be forced to the ground by the weight of the spray. It is important not to water too freely at first, especially if the plants are transferred to the cold frame during either cold or close, humid weather. Watch the plants daily to see whether they need water. Be careful to avoid over watering, but keep the soil moist. During the first two or three weeks general waterings may not be needed but the sides and corners of the boxes should be watered to keep them from becoming too dry. Lack of moisture invariably dwarfs the plants, and if other parts of the flat are sufficiently moist, the plants when ready to set or sell will lack uniformity in size.

Very little if any ventilation is required for a few days after transplanting, especially if the weather is cold. The same is true in hot windy weather when the plants should be shaded and very little air admitted until root growth has been made. After the plants are well established sufficient air should be admitted to the frames daily to induce a strong, stocky growth. Notes on the various crops give additional details on their management in hotbeds, cold frames and greenhouses.

Plants should be well hardened before setting in the field or offering for sale. It is especially important that the hardening process be given careful attention with cabbage, lettuce and other plants which go to the field when hard freezes are likely to occur. Hardening begins at least a week before field planting, by giving free ventilation. The first morning the sash may be drawn so that one-fourth or perhaps one-half the area in the cold frame is exposed. In a day or two the sash may be removed entirely, taking them off early in the morning and not replacing them until late in the evening. The next night, perhaps the mats may be left off and about two nights later leave off the sash. The process should be gradual. When hardened, cabbage plants have a reddish blue color and in this condition they will stand a hard freeze. Tomatoes and other tender plants cannot be hardened to the same extent. A limited supply of water also helps to make tough plants. This is especially true of tomatoes.

STABLE MANURES.

An immense quantity of stable manure is used by gardeners in the vicinity of large cities. It is often depended upon as a source of plant food, although the majority of vegetable growers supplement by the application of commercial fertilizers. Near the large cities, growers often keep a team or two on the road the year round hauling manure and these teams are seldom taken off for any other work. The wagons are usually large and strongly built. At New York, Boston and Philadelphia the wagons are often loaded with from three to five tons of manure (See Figure 11) while in other sections about two tons constitute a load. The largest wagons are sometimes built at a cost of three hundred dollars.

The cost of manure varies greatly. Occasionally growers are paid for keeping city stables clean. In other instances they get all they can pile on their wagons for twenty-five to fifty cents per load whether it is a ton or five tons. When shipped short distances on the train the cost per ton delivered ranges from $1.75 to $2.10. A large operator in Maryland pays from $2.75 to $2.90 for manure delivered on the siding on his farm. The price that a gardener can afford to pay for manure depends upon the quality of the manure, quality and character of the land to be fertilized, crops to be grown and the skill of the grower. The Maryland grower, referred to, attributes his success mainly to the free use of manure, although it has cost him thousands of dollars a year.

Manure is the best fertilizer for vegetable growing, because if used in large quantities the supply of soil humus is maintained and it is then possible to follow an intensive system of annual cropping. Manure keeps the soil loose and friable, retains moisture, furnishes plant food and provides favorable conditions for friendly bacteria.

An application of fifty tons per acre is considered a very heavy one, although larger amounts are sometimes used. Twenty-five tons per acre is a liberal dressing for some crops and even half this amount, supplemented by commercial fertilizer often produces excellent results. It is a fact, however, that those who use manure the most freely are apparently the most prosperous. There is much more likelihood of using too little manure than too much. This is particularly true in the growing of onions, celery and the root crops.

Manure from any of the farm animals is satisfactory for garden work. Poultry manure is, of course, worth the most money, and if produced on the farm it should be carefully preserved for garden work. Practically the only kind used in intensive gardening is horse manure and this varies considerably in quality.

Fig. 11. A Load of Manure in Philadelphia County.

There is a great difference of opinion as to whether the manure should be applied fresh or after it is partly or fully decayed. In field trucking where ten to twenty tons are used per acre the best practice seems to be to haul and spread in the field as fast as it is produced or secured at the stable or railroad siding. Where teams are hauling the year round and the area of cultivated land is quite limited, it is necessary and perhaps an advantage to stack in large piles. At the Maryland Experiment station investigations have been made which seem to indicate that it is desirable to allow manure to decay before applying. The usual practice of intensive growers is to place the manure in flat piles that are four or five feet deep. These should be kept well watered, and turning once or twice hastens decay and improves the mechanical condition. At Boston, shredders are sometimes used before the manure is hauled and spread in the field. It is economy to use manure spreaders to apply piles that may accumulate on the premises.

GREEN MANURES.

Gardeners living remote from the large cities have difficulty in getting a sufficient quantity of stable manure. They realize more than ever before the necessity of maintaining the supply of humus. They know from experience and observation that if humus is wanting the soil bakes, becomes hard, is difficult to farm and produces poor crops. The maintenance of humus is the most difficult problem on most farms.

There are two general lines of vegetable gardening. The first is popularly known as market gardening and this relates to the growing of crops by intensive methods. The farms or gardens are usually small, containing only a few acres while they often contain fifty or more acres. The values may range from a few hundred to several thousand dollars per acre. Manure is used with great freedom on these farms. Every possible effort is made to get the crops in early. The rows are close together and companion or intercropping (page 83) is often practiced. One crop quickly follows another and every foot of the land is made to produce as much as possible. It would be impossible to make this kind of gardening a success without the free use of manure. The second type of gardening has been variously called "trucking," or "truck farming" or "field gardening." The farms are generally much larger than in market gardening and the land values lower. Crops as cabbage, tomatoes, asparagus, sweet corn, muskmelons, watermelons, cucumbers, squashes and sweet potatoes are grown on truck farms, while the usual plan in the market garden is to grow beets, onions, lettuce, carrots, parsnips and many other crops.

In market gardening it is not possible to use catch crops or green manures to any great extent because the land is nearly always busy producing cash crops. In farm gardening the situation is very different. The crops are often removed early in the fall in good time to sow crimson clover or rye. These crops can often be sown at the last cultivation of sweet corn, tomatoes or other crops, so they will have a good start before hard freezing weather. They may then be plowed down the next spring thus increasing the supply of vegetable matter and also utilizing soluble plant foods that might have been wasted by leaching. Many of the best truck farms in New Jersey are managed without the use of stable manures except the small quantity that is produced on the farm. Crimson clover is by far the best cover crop when soil and climatic conditions are adapted to its culture. Where this legume or nitrogen gatherer does not thrive, rye may be substituted to advantage.

Many farms in this State would produce excellent crops of vegetables were the supply of the humus increased. There is no better way to accomplish this than by applying lime and sowing red clover. If the soil is too poor to grow clover, and stable manure is not available, other crops may be grown for manurial purposes until the soil is good enough to start clover.

Various courses of green manuring may be followed to build up the poor lands. The following plan is excellent for most farms. Sow rye in the fall, using three bushels of seed and five hundred pounds of a high grade fertilizer per acre. Plow down the rye the next spring when about two feet high. Apply about two tons of burnt stone lime per acre. Then sow three bushels of oats and one bushel of Canada field peas again using the same amount of fertilizer. Adjust chain or rope on the plow and turn in this second green crop in August and then sow rye, which should be plowed down the following spring and followed with a cash crop as late cabbage or tomatoes. This treatment also puts the land in good condition for potatoes and there should be no difficulty in growing clover after such a course of green manuring, especially if lime is used with liberality.

The soy bean is one of the best crops to increase the supply of humus. It thrives well where cow peas fail. The soy bean succeeds much better in clay soils and at low summer temperatures than the cow pea, although both crops are exceedingly valuable as soil builders.

COMMERCIAL FERTILIZERS.

Successful gardeners recognize the importance of liberal plant feeding. Near the large cities the free use of stable manures has not only solved the problem of getting the necessary supply of plant food but also the more difficult one of getting humus. In the great truck regions of the country enormous quantities of fertilizer have

been used for many years. Wherever there has been difficulty in getting stable manures there has been likewise a marked tendency to increase the annual application of commercial fertilizers. With skillful management the results have been quite satisfactory, but in too many instances the productive power of the land has decreased, not because of the more liberal use of fertilizers but because of negligence in maintaining the supply of humus or in keeping the soil in pure sanitary condition.

Very few definite experiments have been made in the fertilization of vegetables. We know very little about the subject. One grower uses manure freely, perhaps fifty or seventy-five tons per acre. His neighbors peep over the fence, the crops look good, and they decide that this is the only way to grow big crops and so they all begin hauling manure. In many cases the applications are lavish, and the results are usually satisfactory. The growers, of course, continue the practice. As a rule, this class of gardeners think commercial fertilizers are of little value, but in most instances they have no positive information on the subject. The results might be better if less manure were applied and fertilizers used to some extent at least.

In the great trucking regions of the country, fertilizers are used freely, but not always intelligently. One ton per acre is very common and in the majority of cases it has seemed desirable and profitable to use this amount. In intensive gardening the amount is often doubled. There can be no objection to the free use of fertilizers if the land is handled properly in other respects. The supply of humus must be maintained by the use of manure or of green crops and the land must be kept sweet. An extremely acid condition often arises from the free use of chemicals and this is unfavorable to the culture of garden crops. See notes on "Lime and Liming," page 35.

Fertilizers may be employed with perfect safety and with most excellent results where vegetables are grown in rotation with the general farm crops. In field gardening it is not necessary to fertilize so lavishly, and yet the tendency in this type of farming is to supply insufficient fertilizer for maximum crops. The special notes for the culture of the various crops give additional information on this phase of the subject.

It is a difficult matter to decide just what fertilizers should be used for each particular crop. Crops vary in their requirements, seasons differ, there are wide variations in soils mechanically and physically and the soil treatment of every field varies more or less from year to year. It is always a perplexing problem to the practical gardener to decide just what to apply as well as to the amount that will be most likely to return maximum profits.

The gardener should bear in mind that in most instances nitrogen is the limiting plant food element in growing vegetables. He must

have this element in rather large quantities before large yields can be secured. This accounts largely for the free use of stable manure and for the increased popularity of nitrate of soda. In general farming it is not expedient to spend much money for nitrogen which costs from fifteen to twenty cents per pound, because prices received for the crops produced do not justify the expenditure. In market gardening, however, it is a different proposition for high priced food articles are produced, and the grower can well afford to buy nitrogen. It is economy, of course, to use the legumes whenever possible to trap the free nitrogen of the atmosphere, but from a business point of view there need be no hesitation in buying nitrogen.

Nitrogen is especially important for crops of which the leaves or leaf stalks are used for food. The list includes cabbage, lettuce, spinach, celery, kale, endive, Swiss chard, parsley and a few other crops of minor importance. A shortage in either of the mineral elements will certainly effect yields. Most soils need phosphoric acid more than potash although potash is used by vegetables more largely than phosphoric acid as may be seen in the following table:

AVERAGE COMPOSITION OF DIFFERENT VEGETABLES AND THEIR FERTILIZING VALUE.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of potash in one ton.	Approximate fertilizing value of one ton.
Asparagus,	6.0	1.6	6.0	$0 90
Beets,	5.0	2.0	9.0	95
Cabbages,	7.6	2.2	9.0	1 20
Carrots,	3.2	2.0	10.0	80
Cauliflower,	2.6	3.2	7.2	70
Celery,	4.8	4.4	15.0	1 25
Cucumbers,	3.2	2.4	4.8	65
Horseradish roots,	8.0	2.0	20.0	1 70
Lettuce,	4.6	1.4	7.4	80
Onions,	4.0	2.5	3.5	65
Peas,	23.0	6.0	8.5	2 90
Pumpkins,	2.2	3.2	2.0	45
Rhubarb,	2.6	0.4	7.2	55
Spinach,	10.0	3.2	5.4	1 35
Sweet corn, cobs,	4.2	1.0	4.4	65
Sweet corn, husks,	3.6	1.4	4.4	60
Sweet corn, kernels,	9.2	1.4	4.8	1 15
Sweet corn, stalks,	5.6	2.8	8.2	1 00
Sweet potatoes,	4.8	2.0	10.0	95
Tomatoes, fruit,	3.2	1.0	5.4	60
Tomatoes, vines,	6.4	1.4	10.0	1 10

From Penn. Dept. of Agr. Bulletin No. 55.

The above table shows in a very emphatic manner the great need of nitrogen. It not only enters largely into the composition of vegetables but also influences the time of maturity. Vegetables which

mature quickly usually command the highest prices and are generally the best in quality. Vegetables should grow rapidly and nitrogen has more to do with quick growth than either mineral element.

In making up a fertilizer for the various crops, the character and previous treatment of the land to be cropped should be taken into account. If land which is to be planted in tomatoes was highly manured the year before, the addition of nitrogen might cause a rank growth of vine at the expense of fruit. The same thing is true of all other crops as peppers, egg plant, peas and beans, requiring a relatively small amount of nitrogen, while with many crops it would be difficult to apply too much nitrogen.

FORMULAS SUGGESTED FOR FERTILIZERS FOR DIFFERENT VEGETABLES.

	Per cent. of nitrogen.	Per cent. of phosphoric acid.	Per cent. of potash.
Asparagus,	4	8	10
Beans,	2	8	10
Beet,	4	8	12
Brussel's sprouts,	4	8	8
Cabbage, early,	6	8	10
Cabbage, late,	4	8	10
Carrot,	4	8	12
Cauliflower,	4	8	10
Celery,	4	8	10
Corn, sweet,	4	8	10
Cucumber,	4	6	8
Egg plant,	4	5	9
Horse-radish,	4	8	12
Kohl-rabi,	4	8	10
Lettuce,	5	8	10
Melons,	4	6	8
Onion,	6	8	10
Parsley,	5	8	10
Parsnip,	4	8	10
Peas,	2	8	10
Peppers,	4	8	10
Potatoes,	4	8	10
Pumpkin,	4	6	8
Radish,	4	8	12
Rhubarb,	5	8	10
Salsify,	4	8	10
Spinach,	5	8	10
Squash,	4	8	8
Tomato,	4	8	10
Turnip,	4	8	12

It should be clearly understood that the above formulas are merely suggestive and might be varied under different conditions. The gardener, however, knows that he cannot afford to take chances by not applying a sufficient amount of every element.

Factory mixed fertilizers are generally employed by the gardeners in this State, but home mixing is more largely practiced every year.

Complete fertilizers can generally be mixed at home for from five to ten dollars less per ton than they can be purchased. This is quite a saving and well worth taking into account. Again, if the fertilizer is mixed at home the grower knows the source of each material and this is often a great advantage. Home mixing enables the grower to take into account not only the needs of each crop to be grown but the previous treatment and probable condition of the fields to be cropped. This matter is of no little consequence and it is a decided point in favor of home mixing.

Then home mixing has an educational value which should not be overlooked. If the rations are determined and the goods mixed at home, the grower becomes a close student of plant nutrition and he will fertilize with greater skill and better results from year to year.

It is a simple matter to determine the required amount of each material with which to make a fertilizer of a given formula. Suppose we desire to mix a fertilizer containing four per cent. nitrogen, eight per cent. phosphoric acid and ten per cent. potash, and that we have on hand nitrate of soda, fourteen per cent. rock phosphate and muriate of potash. Nitrate of soda contains about sixteen per cent. nitrogen. Every 100 pounds of a ton of fertilizer, must contain four per cent. or four pounds of nitrogen. It is seen at once that we must have four times twenty or eighty pounds of nitrogen to meet this formula and as each 100 pounds of nitrate of soda contains sixteen pounds of nitrogen we must have five times this quantity or 500 pounds of nitrate of soda. The formula calls for eight per cent. of phosphoric acid, or eight times twenty or 160 pounds for a ton. Dividing 160 by fourteen, the per-cent, of available phosphoric acid in the phosphate used, we find that 1,143 pounds of phosphate are needed. Two hundred pounds of potash are required. Muriate of potash contains fifty per cent. of actual potash so it will take 400 pounds of muriate of potash to supply this element. These amounts make a total of 2,043 pounds. If a low grade fertilizer is mixed from the ingredients named it would be necessary to use a filler as sand, dry earth or other foreign matter to make a full ton. It never pays the gardener to buy or mix low grade fertilizers. It is much better to use a smaller quantity of high grade material and thus save freight and labor in handling useless materials. The arithmetic of fertilizers is given in very complete form in bulletin No. 55, of the Pennsylvania State Department of Agriculture.

The operation of mixing is a very simple matter. The various materials to be used are weighed and placed in separate piles on a smooth floor at convenient distances from a sand screen with a quarter-inch mesh. This screen should be tacked on a frame three feet wide and five feet long and placed at an angle of about forty-five degrees. Two men with flat bottomed shovels throw the materials on to the upper part of the screen, taking alternately from the different piles. Some

gardeners prefer to spread the materials in layers in one pile before shoveling. As shoveling proceeds, the lumps roll to the the bottom of the screen and are crushed with the bottom of the shovels. From a practical standpoint this method is just as satisfactory as machine mixing in the factory and the actual cost of mixing and re-bagging need not exceed fifty cents per ton. It is not desirable to mix more than a month in advance of field application or the fertilizer may get lumpy and cause trouble in drilling or distributing.

Fertilizer is most conveniently applied by means of drills. Some of the special drills or distributors may be adjusted to scatter from a few hundred pounds to two tons per acre. Distribution by hand is not a very slow process and is preferred by some of the best growers in the country. Machine application, however, results in more even distribution.

Nitrate of soda also is extensively used as a top dressing after the crops are started. It is unquestionably of great value in furnishing nitrogen in quickly available form and its use is becoming more extensive every year. Amounts varying from seventy-five to two hundred pounds per acre are applied along the rows or about the plants and sometimes it is sown broadcast letting the crystals fall where they will. If the plants are dry there is seldom any injurious effect from burning the foliage. Nitrate is especially valuable when applied after drouth, and before rain. As soon as dissolved the nitrogen becomes available and plants thus treated often take on a darker, richer color within a day's time. The New Jersey Experiment Station has made many experiments with vegetables showing the great value of nitrate of soda. In the mixed fertilizers it is generally desirable to derive part of the nitrogen from nitrate of soda and part from organic materials as tankage, dried blood, fish scrap and cotton seed meal.

LIME AND LIMING.

The liberal and continued use of acid fertilizers and green manures tends to make soils acid. Where there is marked acidity all of the garden crops fail to thrive. It is important, therefore, to keep the soil pure and sweet and this requires the use of lime.

It is wasteful to plow under so that plowing should precede the spreading of lime. It is also undersirable to mix lime with fertilizers. It is often convenient to apply lime to a fall crop so there will be no interference with the heavy application of fertilizers in the spring. When clover is grown in the rotation it is especially important to apply lime as often as may be needed. Lime is also the best known preventive of club root although it often fails to control this serious disease.

The lime requirement of different soils varies greatly. Half a ton of stone lime per acre is sufficient in some instances. Not less than a ton per acre should probably be applied on most truck farms. If the land is largely devoted to the growing of cabbage, cauliflower or other crops subject to the attack of club root it is desirable to use it much more freely. Growers on Long Island sometimes apply seventy-five bushels of stone lime per acre.

TILLAGE.

Proper tillage is of the utmost importance in the growing of vegetables. There is danger of minimizing its value and of magnifying the importance of the other factors as for example, the use of fertilizers. The right kind of tillage is essential to the best results and if this operation is slighted or neglected the results are always unsatisfactory.

Tillage has so many functions that the gardener should be well informed on the subject: (1) It puts the soil in the proper physical condition for the foraging of plant roots. (2) It conserves soil moisture. Soils which are made fine by the use of tools hold more moisture than soils composed of lumps or coarse particles. Again, soils which are stirred frequently thus producing and maintaining a fine surface mulch lose less water by evaporation. (3) It secures conditions which are favorable to chemical activities, thus facilitating such changes as are necessary in the preparation of plant food. It aerates the soil which not only favors chemical changes but is essential to the life of friendly bacteria. (5) It destroys weeds and is often destructive to insects which are harmful to growing plants.

A great diversity of tillage tools are used by vegetable growers. It is important to purchase the best. In buying tools four factors should be considered, namely, their efficiency, rapidity in performing work, durability, and ease to the operator and horses. Cheap tools never pay because they seldom meet any of these requirements.

A common mould-board two-horse plow is necessary on every truck farm. A one-horse plow is very convenient for some lines of work. Disc plows are slowly coming into use and they are worth considering, mainly because their pulverizing power is much greater than the mould-board type. Riding plows are often employed on smooth soils and their use could well be extended in all important trucking sections.

Several kinds of harrows are necessary on most trucking soils. Disc or cut-away types are indispensable on sod or clay lands. Spring tooth harrows are necessary where stones are plentiful, but these tools are often used when disc harrows would do much better work. There should be a Meeker smoothing harrow on every farm. The large number of small discs and the leveling board do better and more

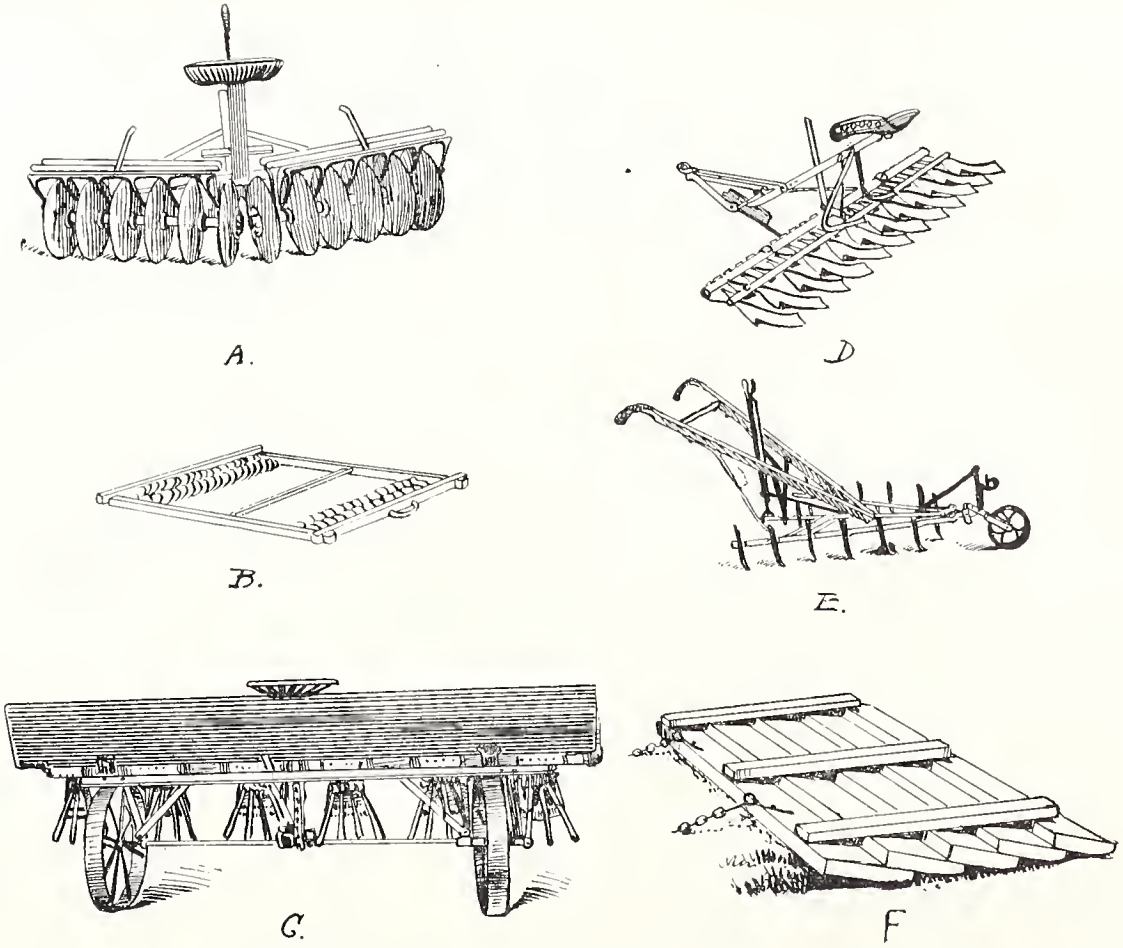

Fig. 12. (A) Disk Harrow. (B) Meeker Harrow. (C) Fertilizer Distributor (D) Acme Harrow. (E) Spike-tooth Cultivator. (F) Plank Drag.

thorough work than is usually accomplished with a garden rake. The Acme is popular on many farms. Although spike tooth harrows are very common throughout the country, they are very inefficient compared with other types just mentioned. (See Fig. 12.)

This chapter would not be complete without mentioning the tools variously designated as a planker, plank drag or float. They are now found throughout the country and are highly valued as pulverizers and levelers. In the preparation of soils for planting, inexperienced gardeners are often puzzled as to the best procedure. In the spring preparation of clay or clay loam the following plan should put the soil in the very best condition for seeding or planting: (1) Plow as soon as the ground is dry enough. (2) Drag the plowed land when dry enough to prevent much soil adhering to the plank. It is usually best to attend to this work daily until the entire field has been plowed and dragged. (3) Disk the land after dragging. (4) Use the disk harrow and drag alternately until the soil is thoroughly pulverized. (5) Give one or two finishing strokes with the Meeker smoothing harrow. Sands and sandy loams do not require so much work in the preparation for planting.

A great variety of cultivators are on the market. All things considered the spike tooth or narrow shovel type is the most efficient. The one-horse cultivators usually contain about a dozen spike teeth or narrow shovels. These are much better pulverizers and conservers of soil moisture than cultivators with a few broad shovels. Riding cultivators can be used to advantage with many crops. Horse weeders are valuable in cultivating such crops as potatoes and sweet corn. The most important point in their construction is that the teeth be rigid as well as strong so they will not break or become permanently bent.

More or less hoeing is necessary in the culture of nearly all vegetables. All kinds of hand work should be avoided as much as possible but it is poor economy to allow the weeds to start and the ground to bake and become hard in spaces which cannot be reached by the horse tools or wheel hoes. Different types of hoes are required for different kinds of work. For the larger crops, where there is plenty of space between plants, the broad blades and rake types should be used as much as possible to economize in labor. (Fig. 13.)

Hand wheel hoes are indispensable in market gardening. Both the single and double wheel types are in common use. When the soil is smooth, level and easily worked the double wheel hoe is entirely satisfactory and economizes labor. One of these tools should be in every farm home to work the home garden even if vegetables are not grown for commercial purposes. They are great labor saving devices, and if all the vegetables were grown in straight rows with space for

using wheel hoes the production of the garden crops would always be a pleasure.

Hand weeders of various styles are shown in Figure 13 and are very serviceable. The weeder in Fig. 8, designed and used by M. Garrahan & Son, of Luzerne county is especially valuable in weeding and thinning.

IRRIGATION.

The lack of soil moisture is the most common cause of disappointment in crop production. This is more true in market gardening than in general farming. The average annual rainfall in Pennsylvania is heavy and yet scarcely a season passes without severe losses in some part of the State.

Water is unquestionably the most important factor in the nourishment of plants. It dissolves plant food and performs many other functions in the soil. It serves as the vehicle to convey food in the soil and in the plant and enters largely into the composition of all vegetables. From a commercial standpoint a full and constant supply of moisture in the soil has three values: (1) It favors early maturity in most instances and early maturity generally means the highest prices. (2) It is essential to maximum yields. (3) It is necessary for the development of the best quality. Quality in vegetables is often a question of succulence. We want crisp, tender, juicy vegetables and the moisture requirements of the plant must be met to secure these conditions. In seasons of drouth the demand for vegetables is keener and prices better. This is one of the strongest arguments for irrigation. A Pennsylvania gardener who irrigates makes the largest profits in seasons of drouth.

It is a fact that a host of vegetable growers in this State lack the necessary facilities for irrigation. Also, there are hundreds of splendid streams in Pennsylvania running through lands that are well adapted to vegetable gardening and where it would be a simple matter to irrigate by modern methods. A few men in the State have seen these possibilities and are now growing more profitable crops because they are prepared to apply water when it is needed.

There are many ways of distributing water as by open ditches and furrows, flooding through tile laid on top of the ground and in subirrigating lines, iron pipes, wooden troughs, and by various temporary sprinkling devices. Any of these methods may be valuable under certain conditions, but the plan which is attracting universal attention among market gardeners and greenhouse vegetable growers is known as the Skinner System of Irrigation.

This system was discovered several years ago by a practical gardener and is being installed rapidly throughout the East. It consists of iron pipes running in parallel lines about fifty feet apart

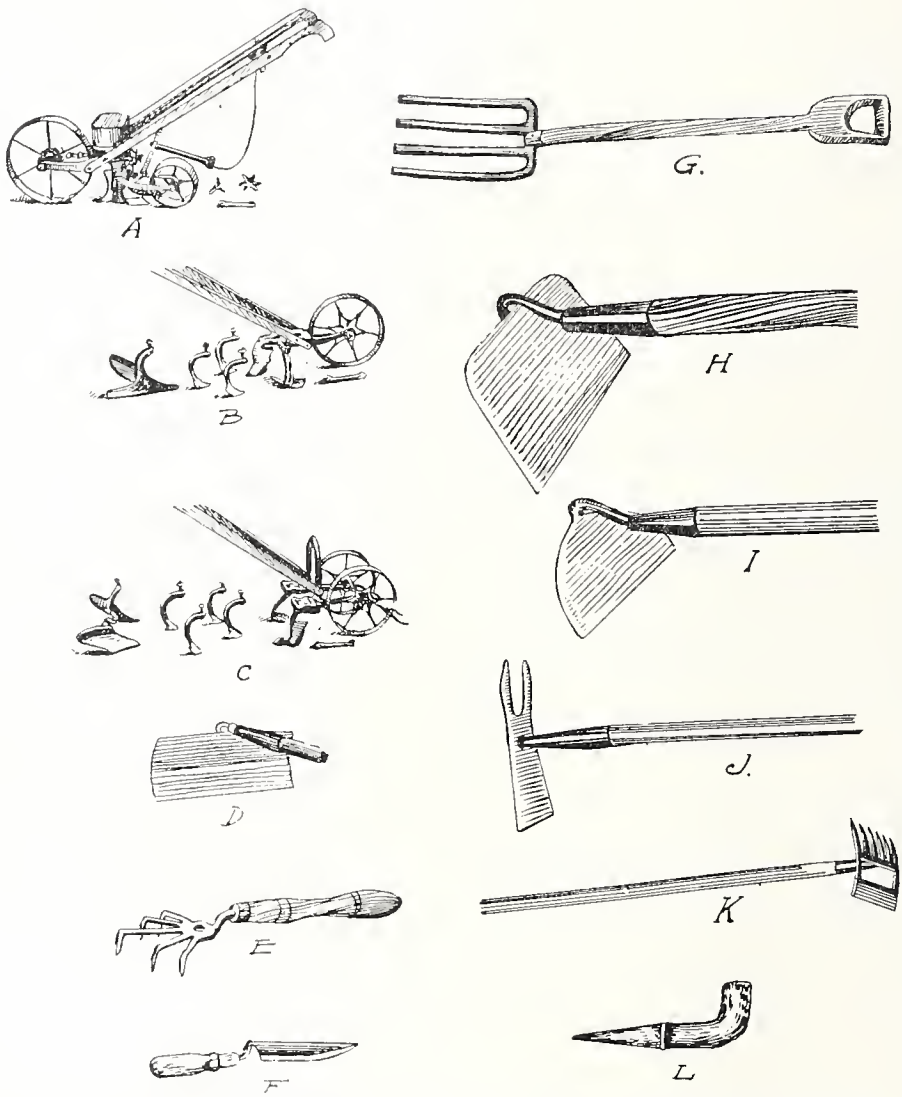

Fig. 13. Hand Tillage Tools. (A) Seed Drill. (B) Single Wheel Hoe. (C) Double Wheel Hoe. (D) Celery Hiller. (E) Excelsior Weeder. (F) Trowel. (G) Spading Fork. (H) Hilling Hoe. (I) Half Moon Hoe. (J) Weeding Hoe. (K) Rake Hoe. (L) Dibber.

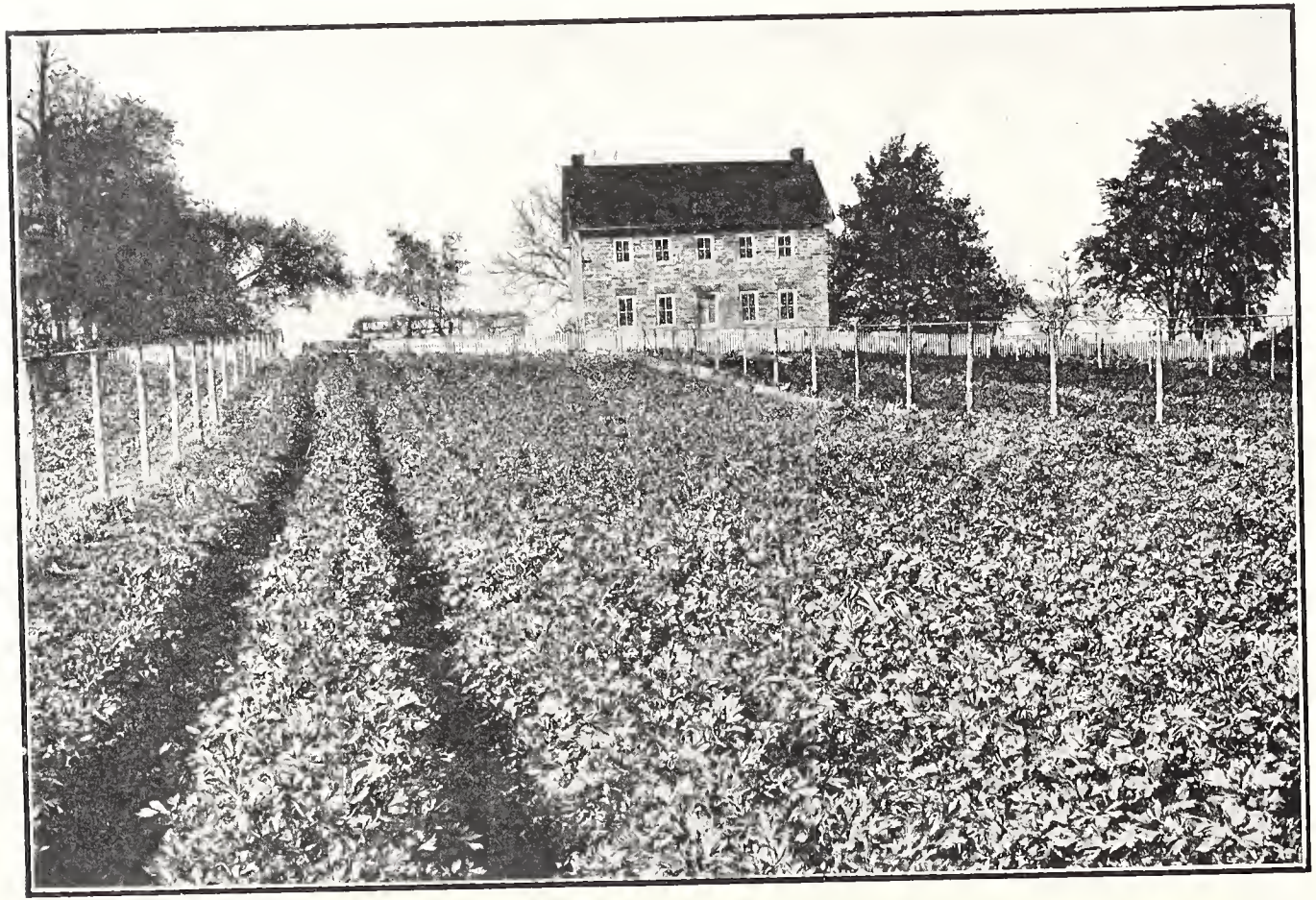

Fig. 14. "Skinner's System of Irrigation Lines—50 feet apart. Cedar Posts."

and at any convenient height from the ground, as shown in Figure 14. At intervals of four feet brass nozzles are inserted which diffuse the water into a fine spray. A patented union makes it possible to turn at will a given line which may be three hundred and forty feet long thus irrigating in the most perfect and thorough manner a strip fifty feet wide and not more than three hundred and forty feet long. The water must flow through the pipe at a pressure of not less than fifteen pounds per square inch although a liberal supply of water is more important than high pressure. The pressure may be secured by piping from reservoirs or streams at higher elevations, or by piping directly into the irrigation lines. Both plans work successfully when properly installed.

The advantages of this system may be stated as follows: (1) Uniformity of distribution. (2) The spray falls so gently that all of the water soaks into the ground without erosion or serious baking of the surface of the soil. (3) The cost of installation is certainly no greater than with many other systems. (4) The cost of operating is much less than with any other system unless it is flooding which is not suitable to vegetable gardening.

Drilling machines may be bought to make holes for the nozzles. The installation of the plant is a simple matter and may be readily accomplished by any intelligent gardener. It is not necessary to give detailed information here about the system for bulletins are issued by the manufacturers of the drilling machines, nozzles and unions which give full instructions for installation and use. A line of this system, as shown in Figure 15, is in use in the gardens at the Pennsylvania State College and visitors will be welcomed at all times to inspect the system.

SEED SUPPLY.

Results in market gardening are largely dependent upon the kind of seed used. Few producers realize the importance of this factor. Maximum yields are not possible without the best seed. High quality cannot be secured without the right kind of seed. Earliness and uniformity in all respects are influenced by the seed used. Whether purchased or grown at home the requirements should be as follows: (1) Freedom from impurities or foreign materials, such as sticks and stones. (2) True to name. If a gardener orders Stone tomato seed the dealer has no right to substitute Matchless although he may consider it just as good. (3) The best strain of Stone or Matchless or whatever the variety and the vegetable may be. Experiments at the Pennsylvania State College show that marked varietal variations occur in different classes of vegetables. (4) The seed under favorable conditions must germinate promptly and there must be a high per centage of germination.

All of these requirements are seldom met. Garden seeds are usually free from impurities, the standard varieties are generally true to name, and as a rule, they grow well, but proper care is not always exercised in breeding high grade seeds. If one strain of Jersey Wakefield cabbage produces one hundred dollars per acre above another strain of the same variety it is time that the growers of cabbage seed adopt better methods.

Most market gardeners depend upon regular dealers for their supply of seed. This has been the custom ever since seed houses were established and will doubtless continue indefinitely. The plan has many points in its favor. It is nearly always cheaper and less troublesome to buy your seeds than to grow them at home. The reputable houses employ experts to grow or supervise the growing of their seeds and the results should be entirely satisfactory. When not satisfactory under favorable cultural conditions it is an evidence of carelessness, negligence or inability in the production of such seed.

Too much care cannot be exercised in buying seeds. Only well known reputable growers or dealers should be patronized. The windy catalogue descriptions of some houses count for nothing. The safe plan is to rely upon your own experience or that of successful gardeners who are producing under similar conditions. Buy only the best. The cost is a secondary matter. Some houses offer several strains of the same variety and as a business proposition it pays to buy those which have been bred with the greatest care, although the cost may be several times as great. When a general line of seed is required it is usually desirable to buy from different houses. One house may have the best strain of a certain variety while another has the best of some other kind. The largest and most successful growers seldom buy all their seed from the same house.

When a grower has been fortunate enough to get an unusually fine strain from a given house, a common practice is to buy enough seed of the same strain to last several years, provided the longevity of the seed will justify it. When this is done, a germination test should be made each year to determine how thickly the seed should be sown.

The practice of saving seed at home is becoming more general among the largest producers of certain classes of vegetables. The advantages of this method depend very largely upon the care and ability of the producer. If it is done carefully and intelligently nothing can be said against the practice, provided the grower has suitable soil and climatic conditions for the production of the seed he needs. There is a tendency, perhaps, to overestimate the influence of soils and climates upon seed production. We know very little about this question. If a gardener has cultural conditions adapted to the growing of any vegetable, it is likely that he can grow his own seed with entire success, although there are exceptions. The fact

remains, however, that many highly successful gardeners in all parts of the country grow most of their own seeds. The argument raised in favor of home production are that there is absolute certainty regarding the variety; if only one variety is grown there can be no mixing; just the type of vegetables may be selected and bred which satisfies the grower and will probably meet market requirements.

The plant and not the individual fruit must be taken as the unit in saving seed. If, for example, the finest tomatoes are selected at random over a field, very little if any progress will be made. If, on the other hand, a plant is found which is strong and vigorous, producing a very large crop of extra fine tomatoes, the bulk of the fruits should be saved for seed purposes and planted in a separate patch. By following this practice from year to year the grower may expect far better results than by saving exceptionally fine individual fruits without taking into account the various plant characteristics also. Among the vegetables which are well adapted to home seed growing in this State may be mentioned sweet corn, tomatoes, cabbage, cucumbers, lettuce, peppers, beets, turnips, onions, muskmelons, watermelons, squashes and beans.

MARKET PROBLEMS.

To dispose of a crop at satisfactory prices is often a more difficult problem than to produce it. Certain factors exert an important influence in getting the most money out of a crop, and inexperienced gardeners should know that these factors cannot be ignored without affecting returns.

(1) Study your market. Find out what it wants. Don't grow a lot of beans if the people want cabbage. Markets vary greatly in the classes of vegetables consumed. This is especially true if the foreign population is large.

(2) Ascertain the few vegetables that are in greatest demand and then make these your leaders if your soil and climate are suitable for their production. It is an advantage to produce a few crops on a large scale. You soon establish a reputation for these specialties. People learn that you have certain crops and naturally look to you for their supply. It is desirable, too, to grow enough vegetables to run the market regularly if the produce is marketed by wagon. If shipping, it is just as great an advantage to make regular consignments. The gardeners who make daily shipments or send a wagon to market every day are the ones who succeed best in holding their trade and in getting good prices.

(3) Earliness is generally, although not always, an advantage in getting good prices. A few days often make a great difference in the prices received. Earliness not only secures better prices but makes easier sales.

(4) Proper grading counts for much in making a crop pay, especially if it is shipped to the cities. One or two under-sized or inferior specimens in a package may repel a buyer or compel the dealer to lower the price. The product in each package should run uniform in size and appearance.

(5) Cleanliness is important. See that all vegetables are bright and clean before offering to the trade.

(6) Adopt a style of package which is popular on your market. As a rule it pays to use small packages when prices are high and large packages when prices are low. A change of style or size of packages when the market is glutted sometimes secures relief. Many points are in favor of the small package. It generally looks better, carries better, sells better and is more convenient to the consumer who perhaps carries it from the grocery to his own home.

(7) The arrangement of vegetables in the package should be pleasing and every possible effort made to secure attractiveness.

(8) The market wagon should be neat, painted and lettered, the team and harness respectable and the personal appearance of the salesman not neglected. The whole outfit will then command respect.

(9) Know the market value of your produce, if possible, before offering to the trade. Be sure you are right as to values and then fix your own prices and don't change if it can be avoided.

(10) Telephonic communications with the market is a great advantage. It is then easy to keep posted on prices. Orders can often be secured by phone with little effort and the merchants will find it convenient to order produce when their supplies run low.

Much might be written on market problems, but the reader is referred to Bulletin No. 202 of the Pennsylvania Department of Agriculture which discusses in a comprehensive way every phase of this important question.

ASPARAGUS.

This is one of the most important truck crops. It is generally grown commercially on a large field scale although with intensive culture on small areas the returns are often equal to the receipts from crops which are more commonly grown by market gardeners. It is certainly one of our best crops, usually finding ready sale on the large city markets and the supply is inadequate to meet the demand in the smaller markets.

The saline, sandy loams near the seashore are best adapted to asparagus, although the crop is grown on a great variety of soil types. Of the inland locations, the sandy loams are unquestionably the best, especially if white grass is to be grown. It is often grown on the heavier soils with entire success. Any soil which will grow a good crop of corn can be made to produce splendid crops of asparagus. The soil must be retentive of moisture and abounding in plant food.

Plenty of manure and fertilizer will generally put the soil in prime condition. Drainage, of course, must be looked after if the soil is not naturally well drained.

A long list of varieties is offered for sale by our nurserymen and seedsmen, but there is no necessity for this confusing list. The most successful growers of the country are almost unanimous in their decision that Palmetto is the best for all soils and all conditions. The plants are strong and vigorous, the shoots large and it is considered more resistant to rust than most other varieties.

Nearly all nurserymen and many seedsmen grow asparagus roots for sale. It is better, however, for the gardener to grow his own roots. It is less expensive and there are several decided advantages. The seed should be secured from strong, vigorous plants containing a few large shoots rather than many small ones. The seed plants should also be free from rust. There are expert asparagus growers in the country from whom seed my be purchased. After the grower has an established plantation it will pay him to select his own seed.

The growing of plants is a very simple matter. The seed germinates slowly and should be sown early in the spring, just as soon as the ground can be prepared. If to be cultivated with a handwheel hoe the rows should be about sixteen inches apart. Drop the seed in shallow furrows, cover with about an inch of soil or more if it is sandy and thin the plants to stand about an inch and a half apart. If the soil is fertile and good care is given the plants, they will be ready to transfer to the permanent plantation the following spring

At this point we must decide whether we will grow white or green grass. For many years the white grass was preferred in our city markets and is still consumed in large quantities. It is considered less troublesome to grow because the ridges of soil protect the shoots from the beetles. On the other hand the rows must be farther apart to provide soil for ridging, the quality is poorer and the prices lower. For these reasons the green product is becoming more popular and is being grown much more largely for all of our markets.

Planting distances vary greatly. The most common practice is to allow about twenty inches between plants in the row. If to be ridged there should be not less than five feet between rows. In the growing of green grass four feet seems to be ample space and on one of the best paying plantations in Ohio the rows are only three feet apart. Four feet is as close as can be planted to permit of thorough cultivation with a horse. To still further facilitate horse tillage, some plant four by four feet.

Unless the soil is in a high state of fertility it may pay to begin soil preparation a year in advance of planting. There should be a liberal supply of humus, so that green manures (see page 29) and stable manures can be used freely and to good advantage. We are

starting a crop to last from ten to twenty years or even longer and too much attention cannot be given to this matter. If the soil is fairly productive, manure and fertilizer may be added and planting started at once. Ten to thirty tons of manure should be used per acre and not less than half a ton of fertilizer. (See page 30). The roots should be planted just as soon as the ground can be prepared in the spring. See that the soil is deep and thoroughly pulverized.

It is well known that the crowns of the plants get nearer the surface of the ground every year. This is due to the fact that the buds form higher each year so that the old stems are attached to the crown lower than the new buds. When the crowns get very near the surface the cultivators and harrows are likely to catch and damage them and to avoid this trouble as long as possible, the roots should be set fairly deep. Years ago they were often set a foot or even more below ground level and trenching was sometimes resorted to in order to provide a very deep soil. Modern practice is radically different. It is now agreed that the roots should not be set deeper than the natural depth of the surface soil. After plowing and harrowing, deep furrows are drawn preparatory to planting and it is generally necessary to use the shovel to secure the proper depth. The ground is then ready for the roots. One year roots are preferred by most growers although two year roots are often used. If the roots are grown at home at least twice as many should be provided as will be needed to fill the plat to be planted. This will permit of selection, a matter which is of the utmost importance. It has been frequently demonstrated that the strongest roots make the largest shoots so that it is never good business policy to plant weak roots. As the market wants large shoots it is important to select not only strong plants but those which contain large buds rather than many small ones. The observance of these two points will materially aid in securing large shoots as well as large yields. Cover the roots with not more than two inches of soil at first and then fill in the furrows gradually as the plants grow until the ground is level. A poor stand is sometimes the result of filling the furrows immediately after planting when many of the small shoots fail to reach the surface.

Clean tillage must be given the plantation for the best results. A cut-away or disk harrow is one of the best tools to use for early spring tillage and it may also be used to advantage after the cutting season. Spike tooth cultivators and a variety of tools are used in summer tillage. In the growing of green grass, ridging should be avoided as much as possible at all times.

The supply of humus in the soil must be maintained. Manure is generally applied in the fall after the tops have been mown. Ten to fifteen tons of horse or cow manure per acre makes a good dressing although intensive growers sometimes use thirty to fifty tons. If more

convenient the manure may be applied any time during the winter. Whatever the time of application, the manure is disked or plowed into the soil the following spring. Commercial fertilizers should also be used with freedom. The most successful growers apply a ton or more. (For formula, see page 32). The entire amount may be applied before disking in early spring or half of it then and half at the close of the cutting season. The latter plan is probably the better. Quantities of nitrate of soda can also be used to advantage at the rate of 100 to 200 pounds per acre and applied at any time the plants seem to need additional food. The most marked effect is doubtless secured when nitrate is used at the close of the cutting season and for the following two months. It is generally desirable to make two or three applications at intervals of about three weeks.

Asparagus should not be cut the second year, although it may be permissible to cut the strongest shoots for a few weeks. It is a question, however, whether the loss is not greater than the gain. A safe plan is to do no cutting until the third year and then make the season not longer than six weeks. After the third year cutting may continue each year until about the first of July. Special knives can be secured for cutting the crop, although large, sharp butcher knives are entirely satisfactory for the green grass. It should be sorted into three grades for the city markets and tied into bunches to meet the requirements of the market to be supplied. Raffia or red tape may be used for tying and a special bunching device should be made or purchased. Both tape and buncher may be secured through seed supply houses. In cutting asparagus, everything should be removed even if the smallest shoots are discarded.

Rust is the only serious disease of asparagus. Mowing and burning the tops after they are matured help to control its ravages. The common asparagus beetle is the only serious insect pest. Spraying with arsenate of lead in young plantations and on lure rows in old plantations is the most approved method of combat. Air-slaked lime destroys the larvae and to some extent repels the beetles.

BEAN.

The different classes of beans are used in large quantities by the markets of Pennsylvania. Most of the soils of our State are well adapted to growing this crop. The best yields are secured on fertile, heavy loams and the limestone soils produce excellent crops.

Preparations for planting should be thorough. Rotten manure can be applied to advantage if the land lacks humus. Commercial fertilizer should also be used. As this plant is a legume, it is unnecessary to use more than one or two per cent. of nitrogen while it is usually profitable to apply eight or ten per cent. each of the mineral elements. The applications range from three hundred to one thousand pounds per acre.

Wax beans are of easy culture. Rust Proof Golden Wax is one of the best varieties, although there are many other excellent sorts. This class of beans may be planted earlier than the more tender classes as the limas. All beans are tender to frost and the seeds decay quickly if the soil is cold and wet. Market gardeners, however, often take chances in planting before the ground is thoroughly warm. If the beans rot the loss is slight and if they grow there is a decided gain in earliness. Wax beans and green-podded bush varieties, as the Red Valentine, may be planted in rows fifteen to eighteen inches apart and cultivated with a hand wheel hoe or planted two feet or more apart and cultivated with a horse cultivator. Deep planting is a disadvantage. An inch or two of fine, moist soil is sufficient covering and greater depth simply retards germination. If planted in drills the plants should stand about three inches apart. Thinning is practiced sometimes if the stand is too thick. Some growers claim that it is an advantage to plant in hills of three or four beans eight inches apart. A hoe can then be used between hills. Wax and green-podded beans are generally sold in upright half bushel baskets.

Lima beans require warmer soil, greater fertility and a longer season than bush beans. The seeds decay easily and should not be planted until the soil is warm and the weather settled. It is probably never desirable to plant them until at least ten days later than is considered safe for corn. The germination is then prompt and the growth rapid.

Pole limas are generally regarded superior in quality to Bush limas and many men of experience claim that although they are more troublesome to grow on account of providing poles, the profits are greater. Early Leviathan is an excellent sort for the cooler sections, while King of the Garden is a splendid later variety. Pole limas should be planted four by four. The poles should be seven or eight feet long and the bark left on to assist in the twining of the vines. Poultry netting also makes an excellent support for lima beans. If the plants are given good care they will bear profusely until frost.

Field beans should be grown more largely in this State. In many other sections of the country they pay better than wheat and improve the soil. The common pea bean is most commonly grown. It should not be planted before the 20th of May in most parts of this State. From one-half to three-quarters of a bushel of seed is required per acre. A bushel of the large beans, as the red kidney varieties, is not too much for an acre. Special planters are on the market or beans may be planted rapidly by ordinary eleven drill grain seeders with seven inch spaces between the tubes. All of the tubes are stopped except the second, sixth and tenth. The drill wheel follows in its outer wheel mark. Three rows will then be planted at a time and they will be spaced twenty-eight inches apart which is right for

horse cultivation. Press wheels attached to the drilling hoes help to secure prompt and even germination as they firm the soil and regulate the depth of covering. Beans should never be cultivated when the plants are wet. It spreads disease and the plants invariably suffer if disturbed when wet.

The most destructive disease of the bean is "pod spot" or anthracnose. Various methods have been suggested for its control, but by far the most efficient means is to select and plant healthy seed. If pods absolutely free from disease are gathered there will be little or no trouble the following year. This is unquestionably the only practical and effective means to keep clear of anthracnose.

BEET.

The beet is one of the most profitable root crops when placed on the market early and it is also desirable to store for late fall and winter sales. It thrives best in the sandy loams although very nice roots may be grown in fairly heavy soils. Fresh stable manures should be avoided, but rotten manure may be used freely. A liberal supply of vegetable matter is essential to the best results and there is no better way to supply this than to make heavy annual dressings of rotten manure.

Beets are often started under glass and transplanted later to the open ground. The plan does not generally meet with favor among gardeners because it is not an easy crop to transplant successfully. If weather conditions are favorable and there is plenty of moisture in the soil the plants recover very quickly. With adverse conditions the plants are stunted and may not produce a crop any earlier than seed sown in the open.

Beets are generally cultivated with hand-wheel hoes having the rows from twelve to fifteen inches apart and the plants thinned from three to six inches depending upon the natural vigor and size of the plants from different varieties and also upon the size of the roots desired by the market. Three to four inches between plants is ample space for the early varieties.

Among the best early varieties may be mentioned Crosby Egyptian, Eclipse and Early Model. The roots of these varieties are rounded or globular and for this reason are often planted for the late crop When wanted for fall or winter use the seed should be sown in June or early in July while early spring is the proper time to sow for the first marketings. Bastian's Half-Long Blood and Long Smooth Blood Red are popular late varieties.

BRUSSELS SPROUTS.

This is one of the many variations in the cabbage family. Instead of a single head at the top of the plant, a large bud or miniature cabbage head is borne in the axil of each leaf. A cluster of

loose leaves constitutes the crown of the plant and the little heads are scattered along the stem which is generally about two feet high. The little cabbage heads are from one to two inches in diameter and are used boiled or pickled. The flavor is more delicate than that of cabbage. This vegetable is scarcely known in the smaller markets but it is quite popular in the cities. The culture is the same as for cabbage, although it does not seem to thrive so well in inland soils as near the seashore. The crop is most largely grown on Long Island and there is quite a demand for "sprouts" in New York. The baby cabbage heads are generally packed and sold in either one or four-quart baskets. They are placed on the market during the fall and early winter from sowings made in the open. The plants do not require more space than Jersey Wakefield cabbage. Long Island Improved is the most valuable variety.

CABBAGE.

Commercially, cabbage is the most important vegetable grown in this State. Both early and late varieties are produced extensively and find ready sale. Notwithstanding the large home production, many thousand tons are shipped into the State every year indicating that maximum production has not been reached. This is particularly true of winter cabbage. Practically the entire State is well adapted to the crop and we should, at least, supply our own markets.

Cabbage may be grown successfully on all the soils of the State. The warm, well drained sandy loams are better adapted to the early crop when quick maturity is important. Yields, however, are always larger on the heavier soils so that for the late crop the clay loams are preferred. Whether for the early or late crop a constant and abundant supply of moisture and a never failing supply of quickly available plant food are the essential factors. High fertility not only means large heads but also quicker maturity.

Of the first early cabbages, Jersey Wakefield is in the lead. It has been grown extensively for many years and with proper breeding will probably continue to be the leading early cabbage grown in the United States. Some newer varieties as Race Horse and Woods Early are making a splendid showing and should receive the attention of market gardeners. Following Jersey Wakefield, Charleston Wakefield is the most prominent variety. It averages probably a third larger and matures about a week later. The two varieties, however, seem to run into each other and it is often difficult to separate the types. Both the Wakefields are pointed cabbages. Winningstadt is another old variety which is still popular for the home garden and it is grown to a limited extent for market. Its

quality is better than Wakefield although the core is larger. It is said to be a fair shipper.

Early Spring is a flat cabbage and ripens with Charleston Wakefield. A large and more solid heading variety of the flat type is Early Summer. There is no truer bred cabbage in America than Succession, but it is considerably later than Early Summer and the heads are also somewhat larger. For a mid-summer cabbage, nothing excels Succession and it is also exceedingly valuable as a late variety for soils which are not fertile enough to grow a satisfactory crop of still later varieties as Flat Dutch and Danish Ballhead. Succession is a certain header if it has even a fair chance. If planted in time it will head in poor soils, although the heads will be small.

The large, late heading varieties as Flat Dutch, Drumhead, Surehead and Autumn King require early sowing and very rich soils for satisfactory results. This is also true of Danish Ballhead which is by far our best cabbage for winter storage. It is possible to grow a fair late crop of Succession where Danish Ballhead would be almost an entire failure. The Danish Ballhead is, as the name indicates, a very hard, round-headed cabbage and is universally grown when long keeping is desired. It is generally considered of superior quality, but if compared with flat cabbages will be found to be coarser in texture and not so sweet. It is an excellent cabbage, however, and should be grown more largely in Pennsylvania because of its long keeping qualities. It is especially adapted to heavy soils and the cooler portions of the State.

Volga is another comparatively new variety which deserves mention. It is crinkled in leaf, the heads rounded-conical but not so hard as the Danish Ballhead. It is a favorite variety with some growers and is adapted to limestone soils. Houser was originated near Harrisburg not many years ago. It possesses special merit in its power to resist black rot. It requires a longer season and perhaps more fertile soil than Danish Ballhead but seems to thrive in lighter soils and in warmer sections where Danish Ballhead does not do well. It is probable that Houser will become the most valuable long keeper to be grown in the southern part of the State.

For the early crop the seed should be sown at least ten weeks in advance of field planting, and better, three months. Ample time should be allowed in order not to force the plants too rapidly. If the seed is sown February 1 the plants should be ready for the cold frame March 1 and for the field April 15. Hardening should begin about April 1. The leaves should have a reddish blue tint, indicating hardiness when the plants are set in the field. They will then stand a temperature of ten to fifteen degrees below freezing.

The time to sow seed for the late crop will depend upon the locality and variety to be grown. In the northern and mountainous portions of the State, May 1 is about right for Succession and two weeks earlier for Danish Ballhead. With a very favorable growing season these dates are perhaps two weeks too early. It is better to sow early, though, than to take chances in sowing too late when a large percentage of plants may fail to make solid heads.

The most important factor in growing late plants is a sufficient amount of soil moisture for the germination of the seed. The sowing is always made in the open ground and it sometimes happens that the ground is too dry for prompt germination causing serious delay in starting the plants. To avoid this trouble the seed bed should be plowed early in the spring and harrowed often enough to conserve the moisture. A still safer plan is to plow and harrow in good time and then mulch heavily with strawy manure until time to sow when the mulch may be raked into piles or windrows and removed. The seed may be sown in drills or broadcast. The drill method is generally used, although broadcasting is preferred by some who claim that the individual plants have more space for their development and that they are stockier and stronger. Half an inch of soil is ample covering if the soil is moist. When broadcasting the seed is raked in lightly with a garden rake. When drilled the rows should be twelve inches apart. Thinning is always an advantage if the plants are crowded.

A thick clover sod, heavily manured provides ideal conditions for this crop. For the early crop it should be plowed in the fall and for the late crop early in the spring. The sods will then be partly decayed and in condition to do the crop the most good. Cabbage is a heavy feeder and it is scarcely possible to fertilize it too liberally. Some intensive growers apply fifty tons of manure per acre before plowing. Most growers, however, are unable to use such a large amount and usually consider themselves fortunate if they can apply fifteen tons per acre. If fertilizers are used with freedom, good crops of cabbage may be grown on sod land without any manure although manure is always desirable.

Fertilizer for cabbage should always carry not less than four per cent. of nitrogen which should be in the form of nitrate of soda for the early crop. The mineral elements are also needed and most growers apply not less than eight per cent. each of potash and phosphoric acid. It is desirable to apply the fertilizer before much harrowing is done and the materials then become thoroughly mixed with the soil. A handful of finely ground bone meal, dried blood or tankage, placed in each hill before setting the plant is an advantage in soils which have not been built up to a high state of fertility.

Fig. 15. Skinner's Irrigation and Celery Culture at the Pennsylvania State College.

Nitrate of soda applied as a top dressing from time to time is also valuable unless the soil contains a large amount of nitrogen.

Planting distances vary greatly, but the following may be used safely for most soils: Jersey Wakefield, 14x26 inches apart; Charleston Wakefield and Early Summer, 15x27; Succession, All-Head, All-Seasons, Early Flat Dutch and other varieties of this type and season, 18x28; Danish Ballhead, 20x30; Flat Dutch, Drumhead and other large late varieties, 22x34.

Machine planting, when properly managed, is entirely satisfactory and often better than hand-planting. When setting by hand a dibber or trowel may be used if the soil is loose, or the holes may be made with hand hoes. The most rapid hand-planting is accomplished by drawing furrows to the proper depth and dropping plants at the required intervals. The soil may be drawn in quickly with the hands from both sides and pressure about the roots firms the soil and secures the plant. The furrows should not be made much faster than the planting is done for the soil soon becomes too dry for safe planting except in damp cloudy weather.

In removing plants from flats or beds as much soil as possible should be kept on the roots. This prevents a serious check in growth and less time is lost in the plant becoming established in its new home.

Thorough tillage is always important for this crop. The cultivators should be started just as soon as the plants have straightened up and used frequently enough to conserve the soil moisture. Shallow tillage should be continued as long as the cultivators can be crowded between the rows. Breaking off an occasional leaf will cause little damage. Figure 16 shows a field of cabbage with very few vacancies.

Cabbage is marketed in a great variety of ways. It is often hauled in bulk to local markets and then sold out by the half-bushel basket, bushel basket, barrel or by count or weight. Selling by weight is the fairest method both to grower and buyer. The early crop when shipped is packed in crates or barrels. The Baltimore crate is ten by eighteen by thirty-six inches inside measurements. It holds, on an average, about one-third less cabbage than a barrel and generally sells for as much money. The crate is the best package to use in warm weather because of better ventilation. It also loads more compactly on the wagon. Small lots of late cabbage are shipped in barrels. Sugar barrels are well adapted to mid-winter shipments. If lined with paper and several thicknesses of paper placed over the top before covering with burlap, the cabbage can be handled in the severest weather.

Danish Ballhead cabbage in the large producing districts is usually stored in specially constructed frost proof houses. The crop

may also be kept in cool cellars or pits. Burying is the most common practice in this State. If the cabbage is sound this method may be used with the loss of scarcely a head. The most economical plan is to bury in a field where the crop has been grown. If more convenient the crop may be hauled to ground near the buildings. It is not necessary to pull the plants as is generally done by home gardeners. It is far better to cut the stems, leaving stubs four or five inches long for convenience in handling the heads. Place the heads in long windrows up and down the slope of the land. Three or four heads may be placed side by side with the stubs down the hill. It is better to lay the heads on their sides than upside down because the outer leaves protect the under side of the head and the stubs do not extend above the soil and thus serve as conductors to carry the heat from the cabbage. Beginning at the upper side of a plant the windrows are continued as long as may be desired, and if crowded for space a row of two or three heads may be placed upon this layer of three or four. Not less than twelve feet should be allowed between windrows. In most sections the cabbage should be placed and ready to bury not later than the 10th of November, although Thanksgiving may not be too late for southern Pennsylvania. A two-horse plow is used to draw two furrows on each side of the windrows, finishing the work with shovels. The cabbage should be covered with about five inches of soil. As soon as convenient, three or four inches of manure is placed over the ridges and in the severest parts of the State it might be safer to use more soil as well as manure. This kind of protection will keep Danish Ballhead until the first of April although it is generally best to begin selling at least two months before this time. A large quantity may be removed on pleasant days and hauled to the barn or suitable outbuilding to be trimmed and packed ready for market. Burying is a troublesome way to handle cabbage but it keeps it in better condition than any other method.

Cabbage has a number of serious insect and disease enemies. The common green cabbage worm may be readily combated by the use of fresh powders as pyrethrum or Slug Shot. Arsenate of lead is also an effective poison when used as a spray. Maggots are often destructive. Their ravages are not so easily prevented. When known to be present, as indicated by flies (resembling the common house fly) flitting about the stems, carbolic acid emulsion should be injected into the ground around the stems.

Plant lice are also destructive some seasons. Dry weather seems to be particularly favorable for their breeding. Both tobacco decoction and kerosene emulsion are used as contact poisons to destroy plant lice on cabbage. The spraying must be thorough and it is necessary to spray the under side of the leaves as well as the upper.

Knapsack sprayers are the most effective for this work. The application of either material is slow and tedious but sometimes necessary to save the crop.

Black rot also causes heavy losses sometimes. The removal of diseased leaves and the application of spray materials are of no value. The only preventive measure is rotation, not planting on the same ground at shorter intervals than four or five years. This is the only safe course to avoid black rot, and also club-root, which is still more dreaded as a disease of cruciferous plants. Club root disease is a slime mould or low form of fungus and extremely difficult to eradicate when the land becomes infested. Liming is the best known preventive measure aside from rotation. It should be used in liberal quantities as seventy-five bushels of stone lime per acre and at least a year in advance of planting cabbage. It often fails to prevent further attacks although considered valuable by most growers. Diseased plants should never be planted and seed should not be sown in land which has grown a crop of cabbage in the previous eight or ten years.

CARROT.

Carrots are consumed quite largely in the cities of the State, but are in little demand in the smaller markets. With proper soil conditions and a good market it is a paying crop.

This vegetable thrives best in a deep, mellow, sandy loam. Sandy soils produce the straightest and smoothest roots. The ground should be made very rich by the use of rotten manure. Special care should be exercised to have the land free from troublesome weed seeds which may germinate before the carrot seed and cause great annoyance. The seedlings are very delicate and are easily smothered by weeds which have started first. Commercial fertilizers may also be used with freedom. Potash seems to be especially valuable for this root crop.

A large number of varieties are in cultivation. The smaller forms are planted for early use and the larger for late use and stock feed. Of the small early varieties, Golden Ball, Early Scarlet Horn, Oxheart and Chantenay are largely planted. Danvers and Long Orange are prominent late varieties. The early varieties may be sown later and are prized by some for fall and winter use. Improved Short White is a very large root, valued for stock feeding.

For the earliest marketings, seed should be sown in the open as soon as the ground can be prepared and successive sowings may be made until nearly the first of July. The seed germinates slowly and for this reason a few radish seed are often sown with carrots and the radish plants mark the rows so that cultivation may be

started before the carrots are up. If the seed is good and the ground in proper condition from twelve to fifteen seeds per foot of row should give a good stand although the seed is sown much more thickly when small roots are wanted. Expense is saved by sowing just the right amount of seed and then thinning is not required. It is often necessary to thin and the plants may be left from one to six inches apart, depending upon variety, soil and size of roots desired. The rows may be only twelve to fifteen inches apart or more space may be allowed so that horse cultivators can be used.

In marketing, the roots are tied together in bunches the same as other root crops or they may be sold in bulk by the bushel or barrel. If the carrots are large, a convenient way to harvest is to draw a plow as near as possible to the roots when they can then be easily pulled and topped.

Carrots may be stored and sold during the entire winter. They will stand some frost, but severe freezing is injurious, so harvesting in the fall should not be delayed too long. The roots keep better if not too ripe when harvested. They may be stored in root houses, caves or well ventilated cellars. The best temperature for storage is slightly above the freezing point. If the atmosphere of the storage room is quite dry a covering of sand or loam will help to prevent withering and drying out.

CAULIFLOWER.

The markets of Pennsylvania are poorly supplied with cauliflower. The main reason for this is that it is much more difficult to grow than its close relative, cabbage. Early cauliflower is especially hard to grow because of the difficulty in raising the plants and the uncertainty of heading in warm weather. Notwithstanding these statements, quite large areas are grown in Philadelphia county and the crop is very profitable. The gardener must certainly be master of every detail in order to succeed.

It is quite generally believed that this vegetable does better at low altitudes where the air is moist and the nights cool. Long Island is by far the largest producing district in the list and the climate as well as the soil conditons there are considered unusually well adapted to the crop. Cauliflower is grown in a great variety of soils, but there is no doubt about the fairly heavy clay loams with gravelly subsoils furnishing the best conditions. The soil should be cool and moist and these conditions do not generally prevail in sandy soils. Irrigation is especially important for inland locations.

It is probably never desirable to apply fresh stable manures for cauliflower, but rotten manure should be used with freedom. The mineral elements should also be employed, but nitrogen should

not be used too lavishly as there may be an excessive growth of leaves without proper head formation.

Although a number of early varieties are advertised by seedsmen, not more than two or three are worthy of attention. Snowball and Dwarf Erfurt have been the leading early varieties for many years. Snowstorm is also a popular early variety, especially for forcing. Seafoam is one of the best late varieties. It is probably also sold as Dry Weather cauliflower. There is no question about it being an unusually successful variety for inland sections.

Too much emphasis cannot be placed upon the importance of buying the very best seed. Much spurious seed is on the market and may be had at low prices. It pays to buy the best, however, although it may cost five dollars or more per ounce. To inferior seed is often attributed the production of "buttons" or the breaking up of the head before it has attained marketable size. Poor seed may also be responsible for non-heading which is most likely to occur in hot, dry weather.

Great difficulty is often experienced in raising early cauliflower plants. I do not know of any vegetable plant which is so likely to damp off in the seed bed or after transplanting. Special precaution must be taken to guard against this loss. Soil sterilization may prevent the disease but perfect cultural conditions are the only certain preventive measures. It is not easy to decide just when the plants should be watered or the house or frame ventilated. Unchecked plants or plants which are making an entirely normal growth probably seldom damp off. The general method of handling the plants is the same as for cabbage, although some growers prefer to transplant twice before setting in the field. In Philadelphia county most of the plants are started in the fall and wintered in cold frames. The plan is very successful. Late plants are grown from seed sown in the open ground, sowing at the same time as for late cabbage. The market desires snowy white heads so that protection is universally practiced to accomplish this purpose. Three methods are used: (1) The breaking of half a dozen or more leaves over the top of the cauliflower head. The stems of the leaves are not severed entirely so that the leaves remain green. This plan is more successful on Long Island than in Pennsylvania where there is a tendency for the leaves to regain their normal position, thus defeating the purpose. (2) Breaking or bending over the leaves as just explained and pinning with toothpicks or small pins. This is a very satisfactory method for all sections. (3) Bringing the leaves together over the head and tying. This is an excellent plan but requires more time than securing with toothpicks. The protection should begin when the heads are about an inch and a half in diameter.

Cauliflower is considered a delicacy on most tables and it pays to exercise special care in marketing. Although barrels are often used, crates or baskets are better. A package which will not hold more than a dozen or at most two dozen heads certainly has an advantage over barrels. If the heads are of good size, snowy white, wrapped in fancy paper and marketed in new, clean packages they cannot fail to attract attention and command good prices.

CELERY.

No vegetable finds more ready sale on the markets of Pennsylvania than celery. Enormous quantities are consumed in the cities and the smaller towns are supplied from the main distributing centers. Although generally grown throughout the State, our markets are mostly supplied by other states. It begins to arrive in July from regions where the early crop is a specialty. California finds it profitable to ship to our market as late as September when our home growers could readily supply the demand. Kalamazoo and New York send immense quantities, and in recent years Florida has been taking possession of our markets late in the winter. This great shipping industry from outside of the State shows the possibilities for growing celery in Pennsylvania. The region about Wellsboro, Tioga county, has been growing large amounts and there are further possibilities in that section. Our people consume large quantities and the crop possesses possibilities of great returns per acre. Few crops will make as much clear profit for area cultivated. It is also true that right cultural conditions must be provided to prevent a total failure. Its culture is now so well understood that every gardener should be reasonably certain of making the crop a success.

The climate of this State is entirely satisfactory for growing celery. Nearly all of our soils, with proper management, will grow a good crop. The reclaimed muck lands are universally regarded the best, considering the matter purely from a business standpoint. Such soils require only moderate fertilizing, are easily cultivated and seldom suffer from drouth. They abound in vegetable matter and this is the most important factor in any celery soil. It is upon this type of soil in all parts of the country that we find the extensive areas of celery.

The trouble on most soils is that drouth interferes so frequently that many gardeners are unwilling to plant large areas unless they are prepared to irrigate. Some gardeners, though, with skillful management, and upon soils that are not naturally droughty, are quite successful. When irrigation cannot be practiced, the grower should be very careful to conserve the natural supply of soil moisture by the early preparation of the soil, heavy annual manuring,

Fig. 16. Field of Early Cabbage.

frequent and thorough tillage and perhaps heavy mulching with manure. Celery is quite generally grown as a second crop following a variety of early crops which are harvested before it is time to plant celery. Market gardeners, following intensive methods, generally have very rich land abounding in vegetable matter which is in prime condition for late celery.

The necessity of high fertility has been previously indicated. Vegetable matter is important and there must be a liberal and constant supply of quickly available plant food. Stable manures are acknowledged to be the best fertilizers. They not only supply humus but also the elements of plant food. Growers following the most intensive methods use from twenty-five to fifty tons of manure per acre and this amount is often applied annually to the same land which is planted in celery every year. A prominent grower at Cleveland, Ohio, has been using fifty tons per acre for many years and his gross receipts have been averaging about $1,200 per acre. The safe policy is to plant no more ground than can be manured in the most liberal way. This will make more clear profit than two or three times as much land which is materially lacking in humus and plant food.

Some growers farming muck soils and using manure do not employ commercial fertilizers. The practice, however, is the exception and there seems to be no doubt that commercial fertilizers can be used in all cases to good advantage. When a gardener begins the use of fertilizers the tendency is to increase the annual applications rather than to decrease them. Very few of the intensive growers apply less than a ton per acre and many double this quantity. If manure is used at the rate of fifty tons per acre and supplemented with two tons of fertilizer it can be readily seen that the outlay for plant food per acre will exceed $100, which may seem excessive. The safe policy is to make certain in using enough manure and fertilizer but it is doubtful whether it is necessary to spend as much as the sum just named. Celery requires a large amount of nitrogen and the mixture should contain not less than four per cent. each of potash and phosphoric acid. Nitrate of soda is also considered exceedingly valuable when used as a top dressing at the rate of 100 to 200 pounds per acre. After the plants are established, nitrate may be used at intervals of about three weeks.

A long list of varieties are offered by the seedsmen, but the gardener need not consider more than half a dozen. Golden Self-Blanching is very generally grown. It is a good grower, easily blanched, compact and of fair quality. It is unquestionably the favorite among gardeners supplying the early market. White Plume is also popular as an early variety. It is larger and much more vigorous in growth than Golden Self-Blanching, but somewhat poorer

in quality. When cultural conditions are not the best and when the market to be supplied is not too critical, White Plume should be planted.

Giant Pascal is a largely grown late variety of superior qualities. Winter Queen is also popular and of good quality. French Success is a newer variety of very compact growth. It is especially valued as a long keeper. Boston Market probably stands at the head of the list of late varieties for quality. It is dwarf in growth, very compact and the stalks small but exceedingly crisp, tender and delicious. It should be grown more largely for market and should always have a place in the home garden. Too much care cannot be exercised in buying celery seed. The best seed of the so-called self-blanching sorts is imported, while California produces excellent seed of the green varieties.

The demand for early celery is not nearly so great as for late. Cool weather seems to be necessary to create much of an appetite for celery, and yet there is an increasing demand for this vegeable during the summer. Prices are better for the early crop so that some gardeners find it quite profitable. There is a tendency for the plants to run to seed if at any time they are checked in growth so gardeners consider it unwise to sow much earlier than the first of March, because there is too much time from sowing until it is safe to plant in the field and the plants are likely to become crowded and stunted. If sown as early as the 15th of February, more space should be allowed the plants after they have been pricked out.

Celery seed germinates slowly and it is very important to sow in a fine soil which does not bake. Sow in drills an inch and a half or two inches apart and then cover the seed with fine soil. See that the soil does not become dry until germination is complete. The moisture may be easily conserved by covering with carpet, burlap or paper until the plants appear. Transplant when of the proper size, spacing the check rows an inch and one-half apart. The expert growers at Cleveland, Ohio, who have been mentioned, plant two by two inches on the greenhouse bench.

Plants for the late crop are usually started in the open (Figure 17) although some of the most successful growers start all plants under glass where there is absolute control of every condition. When grown in the open, the seed should be sown about the time apple trees are in bloom. The rows may be one foot apart which will be ample space to use the hand-wheel hoe. Be careful not to have the seed too deeply covered and the soil should be well firmed after sowing. Burlap, old carpets and various kinds of screens are sometimes used to conserve the moisture until the seeds have germinated. Clipping the tops when the plants get too tall is important to secure stockiness. If this is done at the time of transplanting, the plants

Fig. 17. A Plat of Late Celery Ready for Transplanting.

will suffer less and become established more quickly. Thinning in the seed bed is important if the plants stand closer than about half an inch. Anyone who sees the strong, sturdy late plants grown by transplanting cannot fail to be impressed with the superiority of this method over the usual plan which has just been described.

The space allowed between plants is determined largely by the amount of ground available for the crop and the system to be used in blanching. With the system known as the "New Celery Culture," the plants may be set as close as six by six inches or, better, six by twelve inches. At such close distances the self-blanching varieties become white enough to place on the market without further attention. This system offers great possibilities and yet it is not generally popular. The soil must be exceedingly rich and freely supplied with moisture. The plants are usually set in beds six to twelve feet wide with alleys between. Boards must be used along the outside of the alley rows to secure perfect blanching. This method without irrigation is rather uncertain for an immense amount of water is required when the plants are so close together. In wet weather when the atmosphere is hot and humid there is great danger of the plants rotting. This perhaps is the most serious objection to very close planting.

In some of the best and most successful fields of the country, the plants are set six by twenty-four inches. A horse may be used when setting at these distances, but generally hand-wheel hoes are used. Some very successful growers near Boston plant five by twenty inches. When the rows are two feet apart or less, soil cannot, of course, be used in blanching. The late crop, when blanched with soil, is usually set six or seven inches in the row and from four to six feet is allowed between rows, five feet being the most common space.

Celery should never be planted until after danger of severe frosts. The plants will stand some freezing, but there is danger of checking growth and causing them to run to seed. Plants for the late crop should be set as soon as they are large enough and soil conditions are satisfactory. The soil should be fine and the surface even. Guard against setting them too deep for the plants are easily injured if the hearts are covered.

There is probably no crop that will pay better to irrigate. A very successful plan is to plant six by twenty-four inches, or perhaps closer, and mulch at once with fresh horse manure at the rate of forty or fifty tons per acre. This will make a mulch three to five inches thick depending upon the character of the manure. At first the mulch should be thicker at the center of the row spaces and should not be allowed to come in contact with the plants. If necessary it may be leveled after the plants are larger. With the Skinner

system of irrigation this is an ideal method. The liquid manure is conveyed to the roots and there is always plenty of moisture near the surface of the ground where the roots are feeding. See Figure 17, which shows a crop grown by this method. Where the ground is not mulched it should have frequent and thorough tillage.

Celery is subject to several fungous diseases which may become serious at any time. To avoid trouble and losses the most careful growers spray at frequent intervals with Bordeaux mixture. Some begin making application soon after germination, keeping the plants well armored against disease spores.

Boards are generally used to blanch the early celery as well as late when the rows are too close to permit the use of soil. It pays to buy sound lumber, hemlock being desirable. The boards should be cleated at each end to prevent warping and splitting. With good care they will last for fifteen years or longer. They should never be walked on in the field and when not in use they should be stacked or stored in the dry. Both ten and twelve-inch boards are used but a foot is not too great a width for large celery. Twelve, fourteen or sixteen foot boards are convenient lengths. In blanching, a board is placed along each side of the row and secured by stakes or more conveniently by hooks which are made from very heavy wire. They are simply placed over the upper edges of the boards, holding them firmly in place. Paper is also used in blanching early celery. It is wrapped about the plants and tied or secured with rubber bands. Any kind of fairly heavy brown paper will serve the purpose. A machine has been invented which is drawn by two horses and places paper on both sides of the row, followed by hillers which throw soil against the paper, thus holding it in place. When soil comes into direct contact with the stalks in hot weather they are likely to rust or discolor so that the above machine may find wide use among growers of early celery. Intensive growers who practice close planting cannot use it because of insufficient space between rows.

Earth may be used in blanching during the cool weather of the fall. Preparatory to hilling, "handling" is sometimes practiced, especially if the plants are spreading in habit of growth. This consists in drawing and pressing soil around the lower part of the plant making each stalk take an erect position. Hilling implements are then used frequently enough to keep the stems well covered.

If celery is to be trenched or stored the plants will keep better if not blanched. One of the best and most common methods of trenching may be described as follows: Attend to the work before the plants have been injured by hard freezing. Make trenches ten to twelve inches wide and deep enough for the plants to stand erect with the tops extending two or three inches above ground level.

Fig. 18. Two common methods of bunching celery for eastern markets.

The crop is usually trenched in the field where grown, but if the drainage is not perfect select other ground. The plants must be dry for safe keeping. When trenching, the man stands in the trench with his back to the portion which is being filled. The plants are shoved back between the feet, packed close together and held in place by the legs and feet. The best protection is secured by nailing two ten or twelve-inch boards together making a trough which is placed over the plants as fast as the trench is filled. In warm weather, blocks or other support should be placed under the edges of the boards. As it gets colder the blocks should be removed and a little soil thrown along the bottom of the boards. As the weather gets still colder manure may be thrown over the boards increasing the depth as may be necessary. There is more danger, however, of losses from too little covering, and this is especially true for a few weeks after trenching. Special pits or storage houses are often used and are described in the books on celery culture.

Celery may be tied up in a variety of ways for marketing. Either blue or red tape makes the product appear much more attractive. A common plan is to tie three plants or four, if small, in a flat bunch, as shown in Figure 18. A very desirable method, also, is to tie in dozen lots, as seen in Figure 18. A great variety of crates may be seen on our markets. In general, they should be neat, attractive and not too large. It is better to supply retailers with small lots frequently so the plants will not become wilted or limp before sold.

CUCUMBER.

The cucumber is grown throughout the State for market purposes. It is not one of our most important vegetables from a commercial standpoint, although it is considered profitable by most truckers. It thrives in much colder sections than either watermelons or muskmelons and may be grown in a great variety of soils. Sandy loams doubtless furnish the best conditions, but the heavier soils produce excellent crops when properly handled.

The addition of rotten manure to most soils seems to be essential to the best results. This is especially true of clay soils. A shovelful or two of rotten manure in each hill or liberal distribution in furrows helps to secure large cucumbers and good yields. This special preparation is unnecessary in the sandy or lighter soils which have been built up to a high state of fertility. Land that receives liberal annual dressings of manure should produce a satisfactory crop when manure is spread in the usual manner.

A very common practice is to make raised hills in which the rotten manure has been thoroughly mixed with the soil. Level culture, however, is an advantage if the soil is warm and well drained. Some

of the most extensive growers in the South who supply northern markets, open furrows with one-horse plows, distribute manure in the furrows at the rate of eight to ten tons per acre, plow back the furrows, and then mix with some implement, as a one-horse cultivator with most of the shovels removed. The planting is often done with a horse or hand seed drill, thinning the plants to stand about two feet apart. The rows are usually five to six feet apart. When planting in hills the distances vary as four by four, four by five, four by six and sometimes five by six. More space should be allowed in richer soils.

Commercial fertilizers are generally used in growing this vegetable. For formula, see table on page 32. The amount varies from five hundred to fifteen hundred pounds per acre. This may also be applied in the hill or furrow where it should be mixed thoroughly with the soil to prevent injury to the young plants.

Earliness is an exceedingly important factor in growing this crop. Home-grown cucumbers are wanted as soon as possible by our markets and it pays to make a special effort to produce them early. The plants are easily started under glass. The greenhouse or hotbed furnishes the best conditions. Sow not more than five weeks in advance of the time when the plants may be set in the field without danger of being killed or injured by frost. Earthen pots, paper pots, berry baskets, dirt bands, and inverted sods are employed for this purpose. Not less than three-inch pots should be used. Berry baskets cannot be excelled for starting cucumbers. The pots or baskets should be almost filled with any rich, loamy soil. Plant about eight seeds to each pot or berry basket to insure a good stand and then thin to the two strongest. Plants held in pots or berry baskets longer than five weeks are likely to become stunted and they may not fully recover when set in the field. By using one of the devices mentioned, transplanting may be accomplished without any check in growth.

Cucumbers may be marketed in baskets or crates of any convenient size. (See Bulltin 202 of the Pennsylvania State Department of Agriculture.)

White Spine is the most important variety on the market. Various strains are offered by seedsmen. After a grower has secured good stock, it pays to make careful home selection of cucumbers for seed purposes. Here, as in all other cases, the plant should be the unit rather than fine individual specimens selected in a promiscuous manner.

The striped cucumber beetle is the most destructive enemy. Various methods are used for its control. Fresh, air-slaked lime, sprinkled freely on the plants, is generally effective as a repellant unless the beetles are very numerous. Mosquito netting is often used as a cov-

ering. A successful gardener in this State recommends square frames six inches high and large enough to enclose hills. No mosquito netting or other cloth is placed over the frames. It is claimed that the beetles nearly always fly over the frames.

DANDELION.

Cultivated varieties of the common wild dandelion are grown to some extent for the city markets. The leaves are used mainly as greens and occasionally for garnishing during the spring and fall. Dandelion is an easy crop to grow. The seed should be sown in the spring as soon as the ground can be prepared. For hand cultivation the rows may be twelve to fifteen inches apart and the plants thinned to four to six inches. All flowers should be pinched off to prevent the production of seed. Nitrate of soda is an effective fertilizer for this crop.

EGG PLANT.

The fruit of the egg plant is not consumed in large quantities in the smaller markets, but it is an important vegetable in the large cities. It requires a warm soil, a warm climate and a long season to get best results. Now this does not mean that the egg plant cannot be grown satisfactorily in rather unfavorable locations for the skill of the cultivator makes it possible to modify conditions sufficiently to render it a safe venture. When climatic conditions are unfavorable the gardener should grow the finest plants in large pots and defer field planting until the first of June or perhaps later and the soil should be in the best possible condition.

Sandy loams are the best soils for the growing of egg plants. Heavier types should have liberal applications of rotten manure and of quickly available plant food. In other words the egg plant thrives best in light, warm, well drained, fertile soil. Special hill preparation is sometimes practiced but it is not necessary in good garden soils.

The leading varieties are Black Beauty, New York Improved, Black Pekin and Early Long Purple. The last variety named is especially valuable for cool sections. The fruits are much smaller than the standard late varieties but mature several weeks earlier. High temperatures in the greenhouse or hotbed are required in starting the plants. Seed should be sowed about March 1 in most sections and the plants shifted two or three times before setting in the field. Four-inch pots or berry baskets are excellent for the last transplanting.

As previously indicated, the plants should seldom be set in the open before June 1. The smaller varieties, as Early Long Purple, may be planted two by three feet while the larger growing plants should be spaced three by four or four by four. In order to secure

large specimens a common practice is to pinch off all blossoms after four to six fruits have set. Clean tillage should be maintained at all times. Egg plants are marketed in baskets or crates of various sizes. They carry better in the smaller packages. The young fruits are edible and they are unsatisfactory for cooking when allowed to ripen.

ENDIVE.

Endive is not fully appreciated in this country. It should be generally grown for the home table and for market. The leaves when blanched are used for salad and both the blanched and unblanched for greens. The crop is most commonly used during the fall and early winter although it is also satisfactory as an early summer crop.

Endive is hardy to frost so the crop is well adapted to all parts of this State. It requires the same soil conditions as lettuce, requiring an abundant supply of humus and plenty of plant food in quickly available forms. Nitrate of soda, used as a top dressing, at intervals of a few weeks, is especially valuable.

The Green Curled Winter, White Curled and Giant Fringed are the leading varieties. The plants may be started early in hotbeds and greenhouses, transplanting to the cold frame or to the open ground. This makes it possible to mature a much earlier crop and to realize larger profits. Hardening is important before taking plants to open ground. It is more common, however, to sow seed in shallow drills in the open and thin so the plants stand eight to twelve inches apart. The late crop is started in July or August. Although the unbleached leaves are excellent for greens, the leaves should be well blanched when they are to be used for salad. Blanching makes the leaves more tender and removes the bitterness, and may be accomplished by any method which will exclude the light. One plan is to gather the leaves together and tie with raffia or strings which will not cut the leaves. Another plan is to cover the plants with boards. Large pots with the drainage holes stopped will secure thorough blanching. In the fall, plants are often lifted and stored in trenches, pits, sheds, cold frames or other places where the light can be excluded. It is important that the plants be dry when stored and kept dry while blanching to prevent rot. Decay is likely to begin soon after blanching if the plants are not disposed of.

HORSERADISH.

There is an increasing demand for horseradish roots in the cities and it is sold to some extent on all our markets. The plant is hardy and thrives wherever proper soil conditions are provided. The cultivator should strive to grow long, smooth, unbranched roots and this cannot be accomplished in poor, heavy, stiff soils. Ideal condi-

tions are found in the deep, moist, sandy loams although the crop may be grown in any heavy soil which is well supplied with humus. While a constant supply of moisture is important, wet soils should be avoided. Rotten manure is unquestionably the best fertilizer. It should be supplemented by liberal amounts of the mineral elements.

Horseradish is often grown as a companion crop, but with favorable markets it is profitable to grow alone. It is easily propagated by planting the crowns, but this method is undesirable because it results in branched and crooked roots. The only approved plan is to plant pieces of straight roots which may vary from three to six inches in length. These may be bought from seedsmen or nurserymen. After a crop has been grown, the usual plan is to remove the small lateral roots to plant for the next years' crop. In trimming or cutting the roots, the upper ends are cut square and the lower ends slanting. They are quite uniform in diameter and this method of cutting enables the gardener to plant the right end up. The roots are cut, tied in bundles in the fall or when the crop is sold and then stored in sand or moist soil until time to plant in the spring.

The rows may be two feet or more apart and the roots twelve to eighteen inches apart in the rows. Three inches of covering is sufficient, although the roots are often set at a greater depth. When furrows are opened the roots are usually set slanting, but this is no advantage over an upright position, except that the roots remain in place until covered with soil. When grown as an inter-crop, a large dibber or bar is used to make the holes. The roots may be planted early in the spring as a second crop after peas or other early vegetables.

Horseradish should always be grown as an annual crop. If the roots remain in the ground more than one season the small pieces left in the soil when the crop is harvested may cause a great deal of trouble by growing among other crops in subsequent years. With small, permanent home plantations it is customary to dig the roots in the spring of the year; but in the large commercial fields a portion of the crop is generally lifted in the fall. The roots may then be sold or stored in sand in a cool, dry cellar or cave and disposed of during the winter. The balance of the crop should be harvested early the next spring. The grated roots when mixed with vinegar will keep indefinitely in sealed jars.

KALE.

This vegetable, which belongs to the cabbage family, is of no great commercial importance, although considerable quantity is sold on the city markets. It is most commonly grown as an early spring or late fall crop. The leaves are curled at their edges and the plants

are sometimes grown purely for ornamental purposes. Their chief value is as greens and the leaves are also popular for garnishing, although not so desirable for this purpose as parsley. The climatic, soil and fertilizer requirements are the same as for cabbage.

The plants may be started under glass and transplanted in the open. The more common plan is to sow in the open ground where the plants are to mature, and then thin as may be necessary. The plants should have about the same space in the field as early cabbage. They are not easily injured by freezing and in the milder parts of the State they often pass the winter without much damage. The quality is said to be improved by frost.

KOHL-RABI.

This vegetable belongs to the cabbage family and is valued for its fine edible qualities. The part which is used as food is the turnip-shaped enlargement of the stem immediately above the ground. Kohl-rabi is prepared for the table in the same way as turnips, but it is more highly esteemed by housekeepers who are familiar with both vegetables. The vegetable is not generally known on the markets and it deserves wider acquaintance among all classes. The cultural requirements are practically the same as for cabbage. Rotten manure and fertilizer should be used freely. Quick maturity is important to secure the best quality.

The plants are often started early under glass and handled in the same manner as cabbage plants. The more common method is to sow in drills and then thin to four to six inches. Fifteen inches between rows is sufficient space unless a horse cultivator is to be used. The stems become woody if the crop is allowed to stand too long, so that sowings should be made at intervals of two weeks if a succession is desired. The best known variety is Early White Vienna. The same methods of storing are used as for the turnip.

LEEK.

This vegetable is clearly allied to the onion, but is milder in flavor. It is eaten raw, cooked and used for seasoning. The same cultural conditions are required as for onions. Seedlings may be started under glass, hardened, roots and tops cut back and the plants set in the open, as onions are handled.

Blanching makes the stems milder in flavor and more tender so the plants are sometimes planted five or six inches deep in furrows or in dibber holes. If necessary, ridging may be practiced to secure more perfect blanching. The seed may also be sown in the open, thinning to about two inches apart or closer if the plants are sold when quite small.

LETTUCE.

Lettuce is of great commercial importance in this State. It is grown largely in greenhouses, hotbeds, cold frames and in the open. The readiness of sale depends upon quality and season of year. It varies greatly in quality and is in greatest demand during the spring months.

Lettuce is sensitive to too much heat. The plants thrive best in a rich, moist soil. Rotten manure is by far the best fertilizer. It is often used for this crop at the rate of forty or fifty tons per acre. Commercial fertilizer carrying a high percentage of nitrogen can also be used to good advantage. It is customary with many growers to apply a ton or more of fertilizer per acre. High fertility and a constant supply of moisture secure quick maturity, large heads and heavy yields.

There are three general ways of growing it in the open: (1) To sow thickly in beds and cut the leaves back as wanted for the table. This method is common in home gardens but results in an inferior product. (2) To start the plants under glass and transplant to the open. (3) To sow in drills in the open and thin to the desired distances.

Of the compact heading varieties, Big Boston, May King, and All Heart are the leading varieties, although many others are recommended for field culture. All varieties of head lettuce require more porous or better aerated soils than loose heading varieties. They are also generally regarded as of superior quality. There are many good loose heading varieties but very few if any excel Grand Rapids, which is the leading forcing variety of its class. (4) Cos lettuce is a newer type which is attracting considerable attention. The leaves are long and narrow, tender and excellent in quality when grown in rich moist soils. It possesses a peculiar flavor which is very pleasant to many consumers. Several varieties are worthy of trial.

When started under glass for the early spring crop the seed should be sown about February 1, transplanting from the greenhouse or hotbed to the cold frame about March 1. If cold frame space permits, it pays to plant two by two inches apart. The plants should be well hardened before setting in the open ground which can be done with safety about as soon as the ground can be prepared. Twelve by twelve inches is about the right distance in the field unless a horse cultivator is to be used.

It is also common to sow just as soon as the ground can be prepared for a spring crop and in August for a fall crop. The rows may be a foot apart, thinning from eight to twelve inches. Lettuce should have thorough tillage. It may be marketed in crates, baskets or barrels. The flat, half-bushel basket or chip is perhaps the best package for this crop.

MUSKMELON.

The muskmelon or cantaloupe can be grown successfully in many counties of the State. Choice specimens sell readily at good prices in all our important markets. The greatest opportunity is to supply local markets unless competition is very keen from shippers. Muskmelons prefer warm, well drained soils and the sandy loams are best adapted to the crop. Clay soils which are not too stiff may be made to produce splendid crops by the addition of rotten manure. An open, porous soil is very important and special hill preparation is desirable when this condition does not exist. If rotten manure is not used in the hill, it may be distributed in furrows, mixed thoroughly with plow or cultivator and the seeds drilled in if desired. Eight to twelve tons of manure per acre applied in the hill or furrow should secure satisfactory crops. Commercial fertilizers are also employed in growing this crop. (See formula, page 32.)

A great many varieties are advertised by the seedsmen. Some of the best are Netted Gem or Rocky Ford, Emerald Gem, and Osage and Paul Rose for salmon fleshed sorts.

The seed may be planted in pots and the plants grown in the same way as explained for cucumbers on page 62. This enables the grower to reach the market earlier and makes it possible to grow muskmelons where the summers are too cool and too short to mature a crop.

Planting distances vary greatly. There should be at least five feet between rows and six give better conditions in fertile soils. The plants may stand from two to six feet apart in the row, depending upon the number left at each place and also upon the vigor of the variety. Spraying is often necessary to control diseases. The crop is marketed in baskets and crates of various sizes.

The muskmelon has not been grown on a very large scale in Pennsylvania, although a gardener here and there has found it a very profitable crop. There is no reason why it should not be grown extensively for all our markets. The plant thrives best in warm soils and on sunny exposures. Soils in which there is considerable sand are usually preferred; the crop is always earlier in such soils. Many growers are getting excellent results in clay loams when rotten manure is used in sufficient quantity. Special hill or furrow preparation as directed for cucumbers (page 62) is often necessary.

Varieties differ greatly in many respects. They vary in size, form, color and markings of fruit. The flesh varies from poor to very good in quality and from whitish to deep orange in color. Rocky Ford

has come into prominence in recent years. It varies greatly in type. Netted Gem is an excellent, small, early variety. Montreal Market is the largest of the nutmeg varieties and is largely grown in Canada. Emerald Gem is a small, very early variety of superior quality. Tip Top is a nearly round melon with deep yellow flesh of good quality. Osage is increasing in popularity; fruits are large, round, with thick, sweet, salmon-colored flesh. Paul Rose is a superior variety secured by crossing Osage with Netted Gem.

Muskmelons may be started under glass as directed for cucumbers. (See page 62). An early start is even more important than with cucumbers. The plants must not be checked in growth before setting in the field. An excellent plan is to sow in beds in the hotbed or green house and pick out the plants when about ten days or two weeks old into two-inch pots. When roots begin to mat about the sides of the pots, shift into four-inch pots. This method of culture should avoid any possible check in growth before the plants are set in the open ground. In no case should the seed be sown more than five weeks in advance of field setting.

Muskmelons may be planted in furrows or in hills. The furrow method as explained for cucumbers (page 62) seems to be gaining in popularity. The rows should seldom be closer than five feet and six feet of space is not too much in most soils.

Tillage should be thorough at all times. Some hoeing and hand weeding in the furrows or hills is often necessary. The striped cucumber beetle is the worst insect enemy. For its control, see page 62. Spraying with Bordeaux mixture is frequently practiced to check the ravages of fungous diseases.

If the melons are for a local market, they should not be picked until fully ripe and not until the stem separates readily from the melon are they fully ripe. If for shipment, the fruits must be pulled rather green to hold up until in the hands of the consumer. Quality is always sacrified if the melons are pulled before they are thoroughly ripe.

ONION.

The onion ranks third in commercial importance among the vegetables grown in the United States. It is an important vegetable in this State near the cities, although there are very few large areas. The crop is profitable when conditions are favorable and there is no reason why it should not be grown much more extensively in Pennsylvania. Market prices fluctuate greatly from year to year but average prices are quite satisfactory.

The onion is widely adapted to a great many soil types, and soils which are not naturally congenial to the crop may be made productive by the liberal application of rotten manure. The sandy soil and

sandy loams are unquestionably best adapted to onion culture. Such soils are easily cultivated and furnish ideal conditions for the free development of the bulbs. If the heavier types can be made open and porous by the proper addition of vegetable matter they will produce splendid crops, although the cost of production may be greater than on the lighter soils. Muck soils, when fully reclaimed, furnish most excellent conditions for this crop and the largest areas of onions in the United States are upon these soils. Whatever the character of the soil, the ground should be fairly level, well-drained and free from stones, sticks and other rubbish which would interfere with the use of drills, cultivators and other tools.

Soil, intended for onions, should be put in the best possible condition before planting. A good plan is to grow a hoed crop, such as cabbage, potatoes or sweet corn, the year before planting onions manuring very heavily and giving perfectly clean tillage. This method of treatment will increase the supply of humus and rid the soil of troublesome weed seeds. All stable manures used the same year the onions are grown should be decayed to avoid weeds and to secure the most satisfactory development of bulbs. A common practice is to apply rotten manure at the rate of twenty-five to fifty tons per acre, except in muck soils where commercial fertilizers usually take the place of manure. The fertilizer should carry four or five percent. of nitrogen, seven or eight percent. of phosphoric acid and eight to ten percent. of potash. Part of the nitrogen should be in a quickly available form, as nitrate of soda, or this salt may be used as a top dressing. One-hundred to one-hundred and fifty pounds at a dressing, applied at intervals of several weeks, should encourage a satisfactory growth. Onions are often grown on the same land year after year. While this may be the best policy from a business standpoint, rotation is highly desirable to keep free from insect and fungous trouble.

A large number of varieties are in cultivation. Among the American varieties, the following are grown most extensively: Yellow varieties—Yellow Danvers and Southport Yellow Globe; white varieties—Southport White Globe and Silver Skin; red varieties—Weathersfield and Red Globe. Of the large varieties which are adapted to the "new onion culture" but which do not keep well, the following may be mentioned; Prizetaker, Giant Gibraltar and Denia.

The bulk of the matured bulbs are grown from seed sown in the open ground. For this method prepare the ground at the earliest possible date in the spring and sow the seed without delay. Early sowing is certainly conducive to large yields. The seed is usually drilled in rows twelve to fourteen inches apart and sufficient seed should be used to give eight to ten plants per foot of row. The quality of seed required per acre depends upon the germinating power of

the seed, size of seed, fertility of soil, size of onions desired and distances between rows. Four and a half and five pounds per acre are the most common quantities used by extensive growers. It is exceedingly important to test the germinating power of the seed before sowing so that the proper amount of seed per acre may be determined. The depth of covering should not be more than half an inch in fairly heavy soils, while an inch is not too much in lighter types.

In home gardens a few bushels of onions are often grown from sets. This method, however, does not appeal to commercial growers because of the expense in buying and planting sets and the crop is usually not as satisfactory as from seed.

The "new onion culture" is popular with a small percentage of our growers. Prizetaker is the best variety for this method. The seed is sown in the hotbed or greenhouse before February 1, if possible. Early sowing is important to secure strong, vigorous plants. The seed should be sown in shallow furrows two and a half inches apart. There should be an average stand of eight to ten plants per inch of furrow. The plants must be kept in a thrifty, growing condition to avoid damping off. If the soil is allowed to become very dry and then water is used with freedom, there will be great danger of losses from this fungous disease. Fresh air should be admitted to the hotbed or greenhouse every day. If the soil is fairly heavy, rotten manure and sand should be used in liberal proportions in preparing soil for seed sowing. After the plants are about five inches high, clip back the tops to four inches and repeat this operation once a week until the plants are set in the open ground. This will make them strong and stocky. The stems should be at least three-sixteenths of an inch in diameter when set in the field or garden. Previous to transplanting, shorten the roots somewhat and clip the tops back to three inches. Three by twelve inches is a favorite distance to plant. The plants should not be put out until after danger of severe frosts or freezes. They will stand some frost if well hardened, but severe freezing stunts the plants or kills them outright. When large bulbs of fine quality are grown, special methods should be used in marketing. The bulbs should be bright and clean and packed in special crates of the style in which Bermuda onions are shipped.

Onions are ready to harvest when at least half of the tops have turned yellow. The usual plan is to pull the bulbs in four or five rows and place in one windrow. The harvesting should be done in bright, sunny weather. The onions should be left in the field several days, turning daily with a wooden rake. They may then be cured in sheds, well ventilated lofts or in stacks of covered crates in the field. Onions should be stored in cool, dry, well ventilated buildings and the temperature should not drop below freezing unless the bulbs are frozen and held in this condition all winter or until sold or used.

Practically all market gardeners grow "bunching" onions or onions which are bunched and sold in the green state. They may be grown in a variety of ways. Varieties known as White and Yellow Multipliers are often planted in the fall six or eight weeks before freezing weather and these make very early onions for bunching the following spring. Pennsylvania is most too far north for the best results with Multipliers. When planted in this State the ground should be heavily mulched with manure late in the fall to insure safe wintering. A variety known as the Egyptian is perfectly hardy in all parts of this State. It may be planted at the same time as Multipliers. It is not of the best quality. Yellow, white or red sets are planted in large quantities early in the spring to be sold as bunch onions. A common method in some sections is to sow seed of standard varieties much more thickly than for fully grown bulbs. The quantity used varies from twenty to forty pounds per acre.

The production of onion sets is a profitable industry in some sections. The ground for this purpose should be as free as possible from weed seeds. Seed is sown early in the spring. The spacing between rows may vary from eight to fourteen inches. From forty-five to eighty pounds of seed is used per acre. Onion sets must be thoroughly dried before storing.

The growing of onions requires absolutely clean tillage. The weeds must not be allowed to get a start. The wheel hoe should be used frequently and some hand weeding is necessary to destroy weeds in the rows. The tool shown in Figure 13 is a very useful tool for this purpose.

PARSNIP.

The parsnip is one of our most valuable root crops. It is grown in nearly all home gardens and constitutes an important market crop. A long season and a deep, rich, moist, friable soil are the most important factors for its successful culture. Much straighter and smoother roots are grown in the sandy loams, but by the liberal application of rotten manure, excellent crops may be grown in heavy soils. Fresh stable manure of any kind should never be used for this crop. Half a ton or more of fertilizer per acre (formula given on page 32) will be an advantage, but rotten manure should be relied upon mainly to supply the needed plant food and also to secure the proper physical conditions of the soil. The leading varieties are Early Short Round, Guernsey and Hollow Crown. Seed should be sown in well prepared soil as early as possible in the spring. Early sowing is certainly one of the most important factors in getting a good crop. The seed germinates slowly. Sow thinly in rows not less than fourteen inches apart and thin plants to about four inches apart. Half an inch of covering is sufficient in most soils.

The roots are marketable as soon as they mature in the fall. Freezing improves the quality and for this reason most of the roots in home gardens are not dug until spring. Market gardeners should dig some of the roots in the fall before the ground freezes so hard that digging is difficult. They may be buried or stored in a dry, cool cellar. When stored in cellars, caves or pits, moist sand or soil should be thrown over the roots to prevent drying or shriveling.

PARSLEY.

Parsley is not grown extensively except in the vicinity of large cities. It is used for garnishing purposes as well as for soups, stews and other dishes. For an early crop, the seed should be sown when early cabbage is started or even earlier. The seed germinates slowly and the plants do not make rapid progress until well started. The methods used in starting early cabbage plants apply equally well for this vegetable.

It is also adapted to greenhouse culture. The plants may be easily forced on the bench or on solid beds. When grown under glass the plants may be set at the same distances as lettuce. They may also be used as border plants along tomatoes in the greenhouse or planted on the edge of benches. When grown in the open the rows may be a foot apart and the plants five or six inches apart in the row. A common practice is to sow thinly in the open, covering with half an inch of soil and thinning wherever it may be necessary. Dwarf Perfection, Fern-Leaved and Dark Moss-Curled are excellent varieties.

PEA.

The pea is generally grown in all of the home and market gardens of the State. Its early maturity, delicious flavor and nutritive value make it popular with all classes. Rather extensive plantings are required to secure any considerable quantity and for this reason the crop is not usually popular with intensive growers where acreage is limited. That is, the crop fits in better with trucking or farm gardening than with market gardening.

It is naturally a cool crop and thrives best in all sections when planted in the spring as soon as the ground can be prepared. Midsummer plantings are seldom successful. Earlier maturity is secured in the sandy loams, but the crop may be grown at a profit in all soils when properly treated. Open, porous soils are most friendly to the pea, so compact soils should receive dressings of rotten manure before planting. In very tenacious soils an application of rotten manure in the furrow is a decided advantage. Commercial fertilizers are not used in large amounts for this crop, although some of the most successful growers apply from five hundred to one thousand pounds per acre. For formula, see page 32.

Varieties of peas may be classed according to height into dwarf, half dwarf and tall. Another classification is the smooth or round seeded, the wrinkled seeded and the edible podded. The round, smooth seeded varieties may be planted as early as the ground can be prepared. The most largely planted of this class is Alaska and Nott's Excelsior. The wrinkled varieties should not be planted quite so early because the seeds do not germinate so promptly and the plants are not so hardy. Gradus and Thomas Laxton are largely planted. There are many other excellent varieties of both smooth and wrinkled sorts, dwarf, half dwarf and tall varieties. Melting Sugar is the standard variety of edible podded peas.

The distance between rows depends upon the height of the plants. Dwarf varieties such as Nott's Excelsior need not have more than sixteen inches if cultivated with a wheel hoe. Most of the dwarf varieties are planted in rows thirty inches apart. The tallest varieties, as Telephone, should be three feet apart. The dwarf varieties are much more popular with commercial growers because they do not require support. Peas should be planted at intervals of ten days to insure a succession. The earliest plantings should not be covered with more than an inch of soil, while as the season advances the covering may be increased to three or four inches. It pays to use seed freely. See table, page 84, for amount required.

PEPPER.

Peppers are becoming more popular on all markets. The large sweet fruited varieties are now in demand everywhere. The plant thrives best on warm soils and in sunny exposures. Earliness is an important factor in securing good prices. The plants may be started quite early in hotbeds or greenhouses. Seed may be sown February 15, making two shifts of the plants before setting in the open ground. Rather higher temperatures are required for growing plants than for tomatoes.

Neapolitan is a large, early fruiting variety highly valued by market gardeners. Its earliness renders the variety especially valuable for sections where summers are short and cool. Other large fruited sweet peppers are Ruby King, Bull Nose and Chinese Giant. Varieties with hot or pungent flesh are Tabasco Red Cluster, Long Red Cayenne and others.

RADISH.

The radish is one of the first crops to be sold in the spring. Sandy soils produce the smoothest and best formed roots although a satisfactory crop of the round or olive-shaped roots may be grown in any garden soil which has been made rich, loose and friable by the free use of stable manure. Rotten manure is much the best fertilizer that

can be used for this crop. It is also greatly benefited in mid-summer by irrigation. There must be a full and constant supply of soil moisture to insure quick maturity and roots of high quality. The rows are generally a foot apart and the plants thinned from an inch to four inches apart, depending upon the variety. The depth of soil covering may vary from one-fourth of an inch to an inch. The grower should know the germinating power of his seed and adjust the drill accordingly. Very little thinning will be required if this matter is attended to properly. Radishes are tied into bunches for marketing.

The following are popular varieties: Round or turnip-shaped roots; Scarlet Button, Scarlet Globe and Hailstone. Olive and longer rooted varieties; White Chartier, Beckert's Chartier, Long White Vienna and White Strasburg. Winter varieties: White Chinese and Scarlet China. Seed of winter varieties should be sown about the middle of August in most sections.

RHUBARB.

As an early spring crop, rhubarb is highly valued and is profitable wherever market conditions are favorable. The plant thrives best in deep, rich, loamy soils. Rotten manure should be liberally applied before planting and commercial fertilizer may also be used to advantage. (See formula, page 32.) The plant is usually propagated by dividing the roots. This may be done late in the fall although early spring division and planting is preferred by most gardeners. Quite a common plan is to divide roots in the fall using the large ones for forcing in hotbeds, steam heated frames or greenhouse and ths smaller ones for field planting the next spring. Planting distances vary greatly but three and a half by four feet is satisfactory in most soils. Clean tillage should be maintained.

Two varieties are in cultivation, namely, Victoria and Linneas. The former is more thrifty in growth while the latter, often called Strawberry, because of the pink leaf stalks, is of better quality.

To keep the rhubarb in a thrifty condition, the ground should be heavily mulched with manure every fall and this manure cultivated into the ground early the following spring. Commercial fertilizers and nitrate of soda may be used to advantage. The stalks are tied in bundles for marketing.

RUTABAGA.

This root requires the same soil and cultural conditions as the common turnip. The rows should be about thirty inches apart and the plants thinned to about eight inches apart. Purple Top Swede is the leading variety. The seed should be sown a month earlier than late turnips to insure full maturity before cold weather. The roots may be stored or buried in the same manner as turnips.

SALSIFY.

This vegetable is not appreciated by most families. It is valuable for both soups and stews. The cultural conditions are the same as for parsnips. Seed should be sown as soon as possible in the spring in deep, rich soil. A full season is required to secure large roots. The rows may be twelve to sixteen inches apart and the plants thinned to about three inches. The roots may be left in the ground all winter or a portion of the crop removed late in the fall to be used or sold during the winter. If stored in the cellar, cover lightly with moist sand or soil to prevent withering.

SPINACH.

This is one of the most popular vegetables used as greens. It is grown most extensively in the South where the seeding is made in the fall and the plants wintered without protection. In the North the more common practice is to sow in early spring, just as soon as the ground can be prepared or in cold frames where the crop is matured. Fall sowing, however, is practiced sometimes in the North and the plants usually winter without much injury if the beds are mulched with two or three inches of strawy manure. The crop requires a moist, fertile soil and rotten manure should be used in large quantities. Nitrate of soda is particularly valuable in hastening maturity and in increasing yields. The rows are generally far enough apart to cultivate with a horse although the drills may be only a foot apart when a wheel hoe is to be used. The seeds should be covered with about an inch of soil and about three dozen seed per foot of drill. If there are too many plants, thinning may be practiced. Many growers do not thin until the plants are several inches high when they can be sold. The hardiest varieties should be used for fall sowing.

SQUASH.

The squash requires the same cultural conditions as the muskmelon. It thrives in deep, sandy loams, liberally fertilized with rotten manure. A common practice is to mix several shovelfuls of rotten manure in each hill before planting.

If earliness is important the plants may be started under glass as explained for cucumbers. (See page 62.) This makes it possible to reach the market three or four weeks earlier than when the seed is sown in the open. The distance between hills should be determined by the fertility of the soil and by the vigor of the variety to be planted. The distance for running varieties varies from six by eight, to ten by twelve feet.

There are many excellent varieties of squashes. For summer use, Mammoth White Bush and Yellow Summer Crook Neck are largely planted. The standard fall and winter varieties are Hubbard and Boston Marrow.

Squashes intended for storage should be harvested before severe frosts occur. This is essential to long keeping although early harvesting is often neglected. They should also be handled with care to prevent bruising.

SWEET CORN.

This crop is largely grown by the farmers of the State who have stock to utilize the fodder and thus prevent a waste. An excellent plan is to make ensilage of the fodder as fast as the crop is marketed. In some sections sweet corn is grown extensively for canneries. Soils which will produce a good crop of field corn will grow a successful crop of sweet corn. Heavy clover sods, liberally manured and fertilized furnish ideal conditions for sweet corn.

Prices for sweet corn are usually determined by its earliness. A few days often make a great difference in the price received. Earliness is such an important factor with some growers that glass is used in starting the plants. Berry baskets, earthen pots, dirt bands and paper pots may be used for this purpose. Whatever the desire, there must be no checking of growth, previous to, or at the time of planting in the field. The plan is of doubtful value unless there is assurance of much better prices than from direct field plantings. A southern exposure and sandy loams are important factors in producing an early crop. It is also important to plant early, even at the risk of losing the first planting. The cost of seed per acre is a relatively small matter.

Size of ear is an important matter. Most markets prefer large ears. High quality is also of great importance. Some of the most successful growers use fertilizer at the rate of one ton per acre. This outlay is justifiable if other conditions are favorable for maximum returns.

Many growers plant so as to secure a succession of corn for marketing. This may be accomplished by planting early, mid-season and late varieties at the same time or by making successive plantings of the same variety at intervals of ten days or two weeks. One of the most successful growers in this State has been using the same variety for many years and he sells sweet corn from the 10th of July until killing frosts prevent maturity. All of the seed is grown in a special breeding plat. With this plan, the variety is kept pure and it can be bred up to the highest standard of excellence.

The dwarf early varieties may be planted in rows just far enough apart to get between with a horse and cultivator, while the later and ranker varieties should have not less than three and one-half feet between rows. Plants of the early varieties may stand eight to ten inches apart in the row while later varieties should have about twelve inches of space in the row. The question is often asked, Does

it pay to remove the suckers from sweet corn? According to the results of experiments and the experience of practical growers, there is some advantage in removing suckers and the gain in yield and size of ears will more than pay for the labor required to do this work.

Among popular early varieties, may be mentioned Crosby Early, Adams Extra Early, First of All, White Cob Corry and Premo. Second early—Golden Bantam and Metropolitan. Late—Zig-Zag or Country Gentleman and Stowell Evergreen. The last variety is a heavy producer and grown largely for the canning factories. Golden Bantam, although not so early as some other varieties, is highly valued because of its superb qualities. It is quite generally conceded to be of the highest quality of any variety in cultivation. The grains when ready to use are of a creamy yellow color. This color is objected to by some consumers but when they discover its superb quality the objection to color is usually withdrawn. The plants are productive and the ears of medium size.

SWEET POTATOES.

The sweet potato is not an important crop in this State. It requires a long season, well drained soil containing considerable sand and continuous warm weather. The tubers are bedded in sand in the hotbed or plant house and the rooted plants set in the open after danger of frost. For long keeping the tubers must be stored in a warm, dry, well ventilated room.

SWISS CHARD.

Swiss Chard is not generally known among market gardeners and consumers of vegetables. It is used for greens and may be grown successfully in all soils which have been properly enriched. It is enormously productive and of excellent quality.

A soil which will grow a good crop of beets or spinach will produce Swiss Chard successfully. The plants may be stored under glass and transplanted to the open quite early in the spring although this is probably never done on a commercial scale. In the starting of plants under glass they should have the same general treatment as cabbage.

The usual plan of culture is to sow in the open as soon as the ground can be prepared. The rows may be from fourteen to thirty inches apart. The plants may be cut back to the heart bud over and over again and a new growth will be quickly made. Nitrate of soda is exceedingly valuable in growing this crop. The leaves may be cooked as spinach and other greens and the stalks may be cooked and seasoned like asparagus and served on toast. This vegetable is gaining in popularity. It should be much more generally grown.

TOMATO.

The acreage of this vegetable annually planted in Pennsylvania is probably nearly equal to that of cabbage. It is one of our best vegetables for field culture and it offers possibilities for intensive culture on small areas although it is quite generally regarded as a field rather than a garden crop. Profits usually depend more upon earliness than upon any other factor while yield is exceedingly important, especially if grown for canneries or for the late market.

The climatic conditions of the State are generally favorable to the tomato. It is true that in the northern and mountainous counties the summers are rather short and cool for the highest yields. Improvements in varieties have made it possible, however, to grow a full crop in every section. If early varieties are selected and the plants started under glass and other necessary cultural conditions provided, practically every tomato will ripen in all sections before danger of killing autumn frosts. In many of the more unfavorable sections splendid local markets offer inducements to make a special effort in growing early tomatoes.

Deep, moist, sandy loams are considered ideal for the growing of this crop; but the finest specimens and the largest yields may be grown in all types of soil. Early varieties, as Earliana and June Pink, require light soils to secure fruits uniform in shape, while with late varieties, as Stone, the character of the soil does not exert so much influence upon the shape of the tomatoes. The crop is grown at less expense in soils which are easily cultivated and the tomatoes will be earlier in the sandy or sandy loams. Another advantage of sandy soils is, that the fruits require less cleaning in preparing for market.

Clover sod land furnishes the best conditions for the crop. The ground should be plowed early in the spring. Applications of rotten manure before or after plowing will increase the yield, especially if the land is somewhat thin. If the soil will not grow a good crop of corn it is too poor to grow a full crop of tomatoes. When necessary to grow them under such conditions and where there is a scarcity of rotten manure it will pay to use the available manure in the hills or furrows rather than broadcast it. Commercial fertilizers may also be used to advantatge in amounts varying from five hundred to one thousand pounds per acre. (See page 32 for formula.) If the land has been highly manured for a previous crop it may be judicious to use not more than two percent. of nitrogen and in some instances it is better to omit nitrogen. A liberal growth of vine is necessary for a full yield but excessive growth should be avoided. Fresh stable manures should never be used immediately before planting.

Earliness is a most important factor in making the crop pay. A bushel in July is often worth as much as four or five in September. Early sowing, hotbeds and greenhouses, right selection of varieties and proper methods of culture help to accomplish this purpose.

Earliana is by far the most extensively grown early variety. The fruit is red, quite solid and the vines enormously productive in good soils. Chalk Jewel is a better shaped red tomato, ripening a week later than Earliana. The vines are more vigorous in growth and highly productive. Stone is the standard late red tomato, while Matchless is slightly earlier and fully as desirable in all other respects. Of the pink and purple varieties, June Pink, Globe, Beauty and Trucker's Favorite will give a succession of fruits from July until November.

For the earliest tomatoes, seed should be sown not later than February 20 in the hotbed or greenhouse. Plants from this sowing will be ready to prick out four weeks later. They should be set one and a half by one and a half inches or better two by two inches if there is sufficient space. Three weeks later the second shift should be made, using flats, berry baskets, earthen pots, paper pots, dirt bands, or other convenient devices. If flats are used or the plants set on benches or in solid beds, not less than four inches should be allowed between plants, and five or six inches will secure stronger plants. For the main crop the grower usually feels that he cannot afford to allow more space than four or five inches, while it may pay to give a small percentage of the plants more space so as to get a lead on the market with the earliest fruit. Berry baskets and four-inch paper pots are most excellent in starting strong plants. If each plant carries a cluster of flowers and perhaps a few green tomatoes when set in the field there will be no uncertainty about an early crop if the cultural conditions are satisfactory. For the late crop the seed is often sown the middle of March in this State, but at least two weeks earlier is an advantage in securing a large yield and the bulk of the crop will be harvested before killing frosts occur.

Planting in the field should not begin until after danger of destructive spring frosts. Ten days later than the earliest date for planting corn is usually a safe rule. If strong, stocky plants have been grown, worth twenty dollars or more per thousand, it does not pay to take chances in losing the crop by setting in the field too early.

Planting distances should be determined by the variety grown, the fertility of the soil and the system of training. On moderately fertile soils, Earliana should be planted three by four feet, while four by five is not too much space in fertile soils when the vines are untrained. Four by four is the most common distances for planting. It pays to plant in check rows so the plants may be cultivated both ways.

Single stem training is popular with a few growers. It is claimed that the fruit ripens earlier and is more uniform and less susceptible to rot. Tillage may be continued longer, the fruit picked with greater ease and less cleaning is required in preparing for market. All lateral buds or shoots are pinched out as soon as they appear and the plant trained to a single stem and tied to a stake or wires. This method is largely used at Marietta, Ohio, but is not so popular in this State. The plants may be set two by four feet or even closer. This system involves greater expense in providing posts and in attending to pruning and tying. Another method of training, is to plant two by four feet and to tie up all vines without any pruning. This makes it possible to plant double the number of plants per acre and the yield per plant is apparently almost as great if not altogether.

When wanted for shipping, tomatoes should be picked when they begin to show color. When sold in local markets they should be well colored. Better quality is secured when fruits are allowed to ripen on the vine. After the season is well advanced the fields should be picked every other day to avoid loss from over-ripe tomatoes. The pickers should be cautioned not to remove faulty specimens from the vine and to handle the tomatoes with care. If prices are good the stems should be removed and the fruits thoroughly cleaned before packing. Dipping the tomatoes in water should be avoided if possible for it always softens the fruits and also bruises them to some extent. Careful and tasteful arrangement in attractive packages helps to secure quick sales at good prices. Tomatoes should never be placed in packages that hold more than half a bushel and six basket carriers should be used for the earliest fruits. Bulletin No. 202 by the State Department of Agriculture gives additional information on the marketing of tomatoes.

TURNIP.

This crop is grown on almost every farm and in most of the market gardens of the State. It may be grown cheaply and the roots usually sell at about the same prices as potatoes. The soil and fertilizer requirements are the same as for radishes. (See page 32.) The sandy loams furnish best conditions and produce the finest roots although excellent turnips are grown on almost all soil types.

For the early crop seed should be sown as soon as the ground can be prepared. Rows may vary from twelve inches to thirty inches apart. Seed should not be sown so thickly that much thinning will be required. With the early varieties, the grower should aim to produce a turnip about every two inches, while four or five inches is not too much for the larger late varieties. Late turnips are very

commonly sown broadcast early in August. It is a simple method of culture but results in a larger percentage of small roots than when grown in drills, when the ground can be cultivated and the plants thinned.

Red or Purple-Top, Early White Milan, Early White Egg and Early Flat Dutch are popular early varieties. Purple Top, White Globe, Red or Purple Top and Large Yellow or Amber Globe are excellent for late planting.

THYME.

This is a pot herb which is quite largely grown in Philadelphia county. It is of easy culture. The seed may be sown in the spring after danger of heavy frosts or it may be propagated by rooted layers or divisions. The rows are usually far enough apart to cultivate with a horse. Pick the leaves and tender tips as wanted for market and dry enough to meet the winter demand. Figure 19 shows a fine plat in Philadelphia county.

WATERMELON.

The directions given on page 76 for squashes apply equally well to the growing of watermelons. The crop requires a longer season, warmer weather and warmer soil than squashes. In many parts of the State, if any attempt is made to grow this vegetable, the plants should be started in hotbeds or greenhouses. With an early start the crop should make satisfactory returns whenever soil and market conditions are favorable.

A long list of varieties are offered by seedsmen. The following are some of the best: Fordhook Early, Kleckley Sweet and Halbert Honey.

ROTATION.

In the growing of vegetables, it is desirable to rotate the crops as much as possible to avoid possible losses from insects and diseases and for other advantages. It is true that certain crops as onions and celery, are often grown on the same land for many years without rotating with any other crop and there are many instances where this is unquestionably the best business proposition. As a general principle, however, the advantages of rotation should not be overlooked especially with crops that easily become infested with insects or disease. Closely related plants as cabbage and cauliflower and all other cruciferous plants subject to club root, black rot and other diseases which are difficult to control, should not follow each other. It is also less difficult to control weeds when rotation is practiced.

Fig. 19. Harvesting a Crop of Thyme.

SUCCESSION CROPPING.

Succession cropping is quite generally practiced in market gardening. That is, with high fertility and skillful management three to five crops may be grown upon the same ground in one season. This is intensive gardening and is practiced on land of high value where the area is too limited for more extensive methods, The smaller and quickly maturing crops, as lettuce, radishes, onions, beets, turnips and spinach are grown in succession cropping. For example, lettuce is started under glass and set in the open as soon as the weather will permit. The crop will be sold in May or early in June in the vicinity of Philadelphia. Radishes may follow and beets may be planted after the radishes are sold. With good soil the beets will come off in time to start spinach. The method and order of cropping varies greatly in different sections. If the grower is familiar with varieties and knows the required time for each to mature he should have no difficulty in working out a cropping plan. High fertility, prompt planting, thorough tillage and prompt marketing are essential to make succession cropping a success. Overhead irrigation is especially valuable in this type of gardening.

COMPANION CROPPING.

It is often possible and desirable to practice companion or intercropping as well as succession cropping. Almost innumerable combinations may be made. One very popular plan is to set early cabbage as soon as possible in the spring planting lettuce at the same time or perhaps slightly later.

The arrangement would be as follows, C representing cabbage and L lettuce and the figures planting distances expressed in inches.

C	8	L	8	C	L	C	L	C
14								
L	8	L	8	L	L	L	L	L
14								
C	8	L	8	C	L	C	L	C

The lettuce will be harvested first so there will be practically no interference of the two crops. A row or two of early radishes are sometimes planted between the cabbage rows and occasionally both lettuce and radishes are used as companion crops with cabbage.

Dwarf peas may be planted early in the spring in rows four and a half feet apart, and at the proper time a row of tomatoes may be planted between the peas. The peas should give a return of abut $50 per acre. When the vines are cultivated into the soil the land will be in better condition for the crops that follow.

When the rows of sweet corn are four feet apart a row of beans may be planted between. If care is exercised in harvesting the corn and fodder an excellent crop of late beans should be secured.

The fifth row of onions when planted one foot apart is sometimes removed and sold for bunching and celery planted instead. The other four rows are allowed to mature and after harvesting, all of the ground is given to celery, there being ample space for blanching with earth.

These combinations are merely examples of companion cropping. This system does not appeal to some gardeners. They claim that tillage is more troublesome and that it is more difficult to harvest crops and to combat various insect and fungous enemies. Where the grower is limited in land available for cultivation, he is much more likely to resort to methods of inter-cropping.

NUMBER OF PLANTS REQUIRED PER ACRE AT VARIOUS DISTANCES.

1 in. x 10 in.—627,279.	18 in. x 2 ft.— 14,520.
1 in. x 12 in.—522,720.	18 in. x 30 in.— 11,616.
2 in. x 10 in.—313,632.	18 in. x 3 ft.— 9,680.
2 in x 12 in.—261,360.	18 in. x 4 ft.— 7,260.
3 in. x 12 in.—174,240.	18 in. x 5 ft.— 5,804.
4 in. x 12 in.—130,680.	2 ft. x 2 ft.— 10,890.
6 in. x 12 in.— 87,120.	2 ft. x 3 ft.— 7,260.
12 in. x 12 in.— 43,560.	2 ft. x 4 ft.— 5,445.
12 in. x 15 in.— 34,848.	2 ft. x 5 ft.— 4,356.
12 in. x 18 in.— 29,040.	3 ft. x 3 ft.— 4,840.
12 in. x 24 in.— 21,780.	3 ft. x 4 ft.— 3,630.
12 in. x 30 in.— 17,424.	3 ft. x 5 ft.— 2,904.
12 in. x 3 ft.— 14,520.	4 ft. x 4 ft.— 2,722.
12 in. x 4 ft.— 10,890.	4 ft. x 5 ft.— 2,178.
12 in. x 5 ft.— 8,712.	5 ft. x 5 ft.— 1,742.
15 in. x 18 in.— 23,232.	5 ft. x 6 ft.— 1,452.
15 in. x 2 ft.— 17,424.	6 ft. x 6 ft.— 1,210.
15 in. x 3 ft.— 11,619.	6 ft. x 7 ft.— 1,037.
15 in. x 4 ft.— 8,712.	6 ft. x 8 ft.— 907.
15 in. x 5 ft.— 6,969.	7 ft. x 7 ft.— 888.
18 in. x 20 in.— 17,424.	8 ft. x 8 ft.— 680.

QUANTITY OF SEED REQUIRED PER ACRE.

Asparagus, 2½ ounces to 100 feet of drill; 2 pounds should produce enough roots to plant an acre.

Beans, dwarf, 1 quart to 100 feet of drill; 1¼ bushels per acre. Lima, ¾ bushel to an acre. Pole, 1 pint to 100 feet drill; ½ bushel per acre. Soup beans, ½ bushel to ¾ bushel per acre.

Beet, 1 ounce to 50 feet of drill; 4 pounds to an acre.

Broccoli, 1 ounce to 300 feet of drill; 2 ounces per acre.

Cabbage, 1 ounce to 300 feet of drill; hotbed or greenhouse 1 ounce should produce at least 2,000 plants; outdoors, 1 pound should produce at least 20,000 plants.

Carrot, 1 ounce to 100 feet of drill; 2½ pounds to an acre.

Cauliflower, 1 ounce should produce 3,000 or more plants.

Celery, 1-3 ounce to 100 feet of drill; 1 ounce should produce at least 10,000 plants.

Sweet Corn, ¼ to ½ pint to 100 hills; when planted in hills 1 peck to an acre.

Cucumbers, 1 to 2 ounces to 100 hills; 1 to 2 pounds to an acre.

Egg Plant, 1 ounce should produce 1,500 to 2,000 plants.

Endive, ¼ ounce to 100 feet of drill; 4½ pounds per acre.

Kale, 1 ounce to 300 feet of drill.

Kohl-rabi, 1 ounce to 300 feet of drill; 4 pounds per acre.

Leek, 1 ounce to 100 feet of drill; 4 pounds per acre.

Lettuce, ¼ ounce to 100 feet of drill; 3 pounds to an acre.

Melons, musk, 2 ounces to 100 hills; 4 x 4 feet, 2 pounds to an acre.

Onion, seed, ½ ounce to 100 feet of drill; 4 to 5 pounds per acre. Sets, 1 quart to 40 feet of drill; 8 bushels, and more, if large, per acre.

Parsley, ½ ounce to 100 feet of drill; 3 pounds to an acre.

Peas, 1 to 2 pints to 100 feet of drill; 1½ to 2½ bushels per acre.

Pepper, 1 ounce should produce 1,500 plants.

Radish, 1 ounce to 100 feet of drill; 10 to 12 pounds per acre.

Rhubarb, 1 ounce of seed to 125 feet of drill; 3½ pounds to an acre.

Salsify, 1 ounce of seed to 100 feet of drill; 8 pounds to an acre.

Spinach, 1 ounce to 100 feet of drill; 3-16 pounds to an acre; broadcast, 30 pounds to an acre.

Squash, summer, 4 ounces to 100 hills. Fall and winter, 8 ounces to 100 hills.

Tomato, 1 ounce of seed should produce 3,000 to 4,000 plants.

Turnip, 1 ounce to 200 feet of drill; 1 to 2 pounds to an acre.